SPECIAL NOTE.

Part VI., relating to Stanchions, is compiled in accordance with the Amendment of London Building Acts, London County Council (General Powers) Act, 1909, Part IV., with respect to Buildings of Steel Skeleton Construction in London

Part II., also relating to Stanchions, complies with the London Building Acts, 1894 to 1908, and Provincial Building Requirements.

The remainder of the book is of general application.

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HANDBOOK
OF
STRUCTURAL STEELWORK.

REDPATH, BROWN & CO., LIMITED
(On the Admiralty, War Office and India Office Lists)

HEAD OFFICE OF THE COMPANY:
2 ST. ANDREW SQUARE, EDINBURGH.

WORKS AND STOCKYARDS:
LONDON, EDINBURGH,
MANCHESTER, GLASGOW.

See overleaf for the full addresses of the various establishments of the Company.

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Head Office of the Company:

2 ST. ANDREW SQUARE, EDINBURGH.

Telegrams: EVAPORATE, EDINBURGH. **Telephones:** CENTRAL 6242, 6243.

Works and Stockyards:

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ADDRESSES.

LONDON—City Office:
3 Laurence Pountney Hill,
E.C. 4.

Telegrams: ARBEE, CANNON, LONDON.
Telephone: CITY 1006.

Works:
Riverside Works,
East Greenwich, S.E. 10.

Telegrams: REDPATHIAN, EASTGREEN, LONDON.
Telephone: GREENWICH 230.

EDINBURGH:
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Albion Road.

Telegrams: REDPATH, EDINBURGH.
Telephone: CENTRAL 9030.

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Office—19 Waterloo Street.

Telegrams: JOISTS, GLASGOW.
Telephone: CENTRAL 3512.

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Telephone: TRAFFORD PARK 52.

BIRMINGHAM:
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Telegrams: CHANNELS, BIRMINGHAM.
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LIVERPOOL:
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Telephone: CENTRAL 2397.

CARLIN HOW, YORKSHIRE:

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Telephone: LOFTUS 30.

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Telegrams: REDPATH, MIDDLESBROUGH
Telephone: MIDDLESBROUGH 1007

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PREFACE, 1915 EDITION

(Reprint of
2nd Edition of 10,000 Copies).

Our object in issuing this Handbook of Structural Steelwork is to place before our clients, in as convenient a form as possible, all the data required for the design of Structural Steelwork.

We take this opportunity of emphasising our ability to give **immediate delivery.**

Our facilities in this respect are unique for several reasons:—

1. We have the largest and most varied stock of Structural Sections in the United Kingdom, amounting in the aggregate to over **20,000 tons.**
2. In addition to our four Stock-yards, we have fully equipped Structural Works at each of our establishments.
3. On receipt of orders, our works obtain material from our stocks, and workmanship is commenced at once.
4. The usual vexatious delays, due to waiting for materials coming from rolls, are thus obviated.

A brief description of our stock is given on the following pages.

RANGE OF STOCKS.

The sections of Steel Joists, Channels, Angles, and Tees, which we stock, are those recommended by the British Engineering Standards Committee.

All sections are stocked in varying lengths up to the following limits:—

Steel Joists,	up to 40′ 0″
" Channels,	up to 40′ 0″
" Angles,	up to 40′ 0″
" Tees,	up to 40′ 0″
Rolled Edge Steel Flats and Plates, in all usual widths and thicknesses,	up to 40′ 0″
Round Bars for Solid Steel Columns, from 2½″ upwards,	up to 30′ 0″
Bridge Rails,	up to 40′ 0″

We also stock Broad Flange Beams, particulars of which are given on page 11.

Complete Stock Lists may be had on application. Clients at home or abroad specifying these sections can depend on their requirements being supplied promptly.

Our usual Shipping Ports are:—

LONDON, LIVERPOOL, MANCHESTER, GLASGOW,
MIDDLESBROUGH, AND LEITH.

QUALITY OF STEEL AND TESTS.

The whole of our stock material is of uniform quality, and is supplied to us by the makers to the following tests, which are those accepted by the Admiralty and Lloyd's Inspectors, and are also in accordance with the British Standard Specification for Structural Steel :—

Ultimate tensile strength not less than 28 tons nor more than 33 tons per square inch.

Elongation not less than 20 per cent. on a length of 8 inches.

All our stock material is bought on the understanding that it complies with these tests, and every precaution is taken by us to ensure this.

As much valuable time is lost when materials are ordered from the rolls, we strongly recommend our clients to specify "stock material" on all occasions. By so doing it is possible to take full advantage of our facilities for giving **immediate delivery.**

ROLLING MARGIN.

In each case the weight per foot given in the tables is the minimum that can be rolled, and is subject to a rolling margin of 2½ per cent. over. This margin is claimed by the rolling mills, and should be allowed for in all calculations of weights.

WEIGHT OF STEEL.

All weights per foot given in the tables are calculated on the basis that a cubic foot of steel weighs 489·6 lbs., *i.e.*, a piece of steel 12″ square by 1″ thick weighs 40·8 lbs.

SPECIFIED LENGTHS.

All sections, either from works or from stock, are cut to a margin of 1″ over or under the specified lengths.

When sections are ordered to be cut exact, which means within ⅛″ of specified lengths, the usual extra is charged.

All orders are executed by us subject to the above conditions.

STOCK-YARDS AND WORKS.

Our establishments at Edinburgh, London, Glasgow, and Manchester are each complete units, consisting of Commercial and Technical Offices, Stockyards, and Workshops. A general idea of the extent of these may be had from the photographs included in this Edition.

Our several works are fully equipped with the latest machinery for the rapid and accurate manufacture of all classes of structural Steelwork.

Efficient technical staffs, whose services are at the disposal of our clients, are maintained at all our works.

We are always willing to submit complete schemes or to give estimates from architects' or engineers' designs.

SCOPE AND ARRANGEMENT OF THE BOOK.

Extended reference to the Contents is not necessary here, as an Index is provided, but the following general notes may be of interest:—

The arrangement of the book in its present form is the result of our having had constantly in view two matters of primary importance.

1 To give a selection of Compound Girders and Stanchions, sufficiently complete to obviate the making of a number of those minor calculations, which have been necessary when using any Section Book hitherto published.

2. To present the essential information respecting any Compound Section in one place to avoid the necessity of consulting different parts of the book for its composition and properties.

It will be found that our tables of Compound Girders and Stanchions are exceptionally comprehensive, and include all the forms in common use with a full range of plate thicknesses for every Standard Section sufficiently deep to be riveted.

As a further convenience the book is arranged in parts, each having a Contents page, and containing notes and formulæ explaining in detail the tables to which they refer.

A careful perusal of these notes should be made.

Suggestions for details of construction and standardised connections are given in Part V., and, while these cannot always be rigidly adhered to, economies both in time and material may be effected in many cases by attention to them.

The properties and reference marks of the British Standard Sections of Steel Joists, Channels, Angles, and Tees have been taken, by permission, from the lists of the Engineering Standards Committee, and while these have been used (so far as applicable) in compiling the tables, the Engineering Standards Committee is in no way responsible for any of the figures which we publish.

All the tabulated results have been calculated and arranged by our Technical Department.

Safe loads are given in even figures to the nearest ton less, or, if the loads are small, to the nearest first decimal less, as we consider any greater degree of accuracy unnecessary.

In conclusion, we express the hope that this handbook may be found useful by all engaged in the design of Structural Steelwork, or otherwise interested in those materials or structures which we supply.

REDPATH, BROWN & CO., LTD.

BROAD FLANGE BEAMS.

In addition to the British Standard Sections of Steel Joists we stock the following sections of Broad Flange Beams:—

14″ × 12″ × 101 lbs. per foot.
12″ × 12″ × 82 lbs. ,,
11″ × 11″ × 76 lbs. ,,
10″ × 10″ × 61 lbs. ,,
9″ × 9″ × 51 lbs. ,,
8″ × 8″ × 44 lbs. ,,
7″ × 7″ × 35 lbs. ,,
6″ × 6″ × 25 lbs. ,,
5½″ × 5½″ × 24 lbs. ,,

PART I.

GIRDERS.

SAFE LOADS

AND

PROPERTIES,

Etc.

CONTENTS OF PART I.

PAGE

Steel Joists, - - - - - - - - - - - - 16

Compound Steel Girders—

Single Joist Type, - - - - - - - - - - 20

Double " " - - - - - - - - 30

Triple " " - - - - - - - - - - 40

Rivet Pitch, - - - - - - - - - 50

Moments of Resistance, - - - - - - - - 60

Single Joist Type, plated on one flange only, - - 68

Steel Channels, - - - - - - - - - - 70

Compound Steel Girders—

Double Channel Type, - - - - - - - - 74

Steel Plate Girders, - - - - - - - - - - 76

Steel Box Plate Girders, - - - - - - - - 78

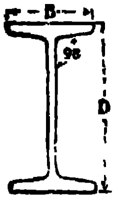
Steel Angles, - - - - - - - - - - 80

" Tees, - - - - - - - - - - - 92

" Joists embedded in concrete, - - - - - - 100

Explanations of Tables, - - - - - - - - 108

REDPATH, BROWN & CO., LIMITED.



STEEL JOISTS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		10	12	14	16	18	20	22	24	26	28	30	32	36	40
BSB 30	24 × 7½		92·2	79·0	69·1	61·4	55·3	50·3	46·1	42·5	39·5	36·8	34·5	30·7	27·6
BSB 29	20 × 7½	83·6	69·6	59·7	52·2	46·4	41·8	38·0	34·8	32·1	29·8	27·8	26·1	23·2	20·9
BSB 28	18 × 7	63·8	53·2	45·6	39·9	35·5	31·9	29·0	26·6	24·5	22·8	21·3	19·9	17·7	15·9
BSB 27	16 × 6	45·4	37·8	32·4	28·3	25·2	22·7	20·6	18·9	17·4	16·2	15·1	14·1	12·6	11·3
BSB 26	15 × 6	41·9	34·9	29·9	26·2	23·3	20·9	19·0	17·4	16·1	14·9	13·9	13·0	11·6	
BSB 25	15 × 5	28·5	23·8	20·4	17·8	15·8	14·2	13·0	11·9	11·0	10·2	9·5	8·9	7·9	
BSB 24	14 × 6*a*	38·1	31·7	27·2	23·8	21·1	19·0	17·3	15·8	14·6	13·6	12·7	11·9		
BSB 23	14 × 6*b*	31·5	26·2	22·5	19·7	17·5	15·7	14·3	13·1	12·1	11·2	10·5	9·8		
BSB 22	12 × 6*a*	31·3	26·1	22·3	19·5	17·5	15·6	14·2	13·0	12·0	11·1				
BSB 21	12 × 6*b*	26·3	21·9	18·8	16·4	14·6	13·1	11·9	10·9	10·1	9·4				
BSB 20	12 × 5	18·3	15·3	13·1	11·4	10·2	9·1	8·3	7·6	7·0	6·5				
BSB 19	10 × 8	34·5	28·7	24·6	21·5	19·2	17·2	15·7	14·3						
BSB 18	10 × 6	21·1	17·6	15·1	13·2	11·7	10·5	9·6	8·8						
BSB 17	10 × 5	14·6	12·1	10·4	9·1	8·1	7·3	6·6	6·0						
BSB 16*	9 × 7	25·5	21·3	17·9	15·9	14·2	12·7	11·6							

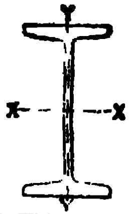
Tabular loads to right of zig-zag line will produce deflection greater than 1/26th of an inch per foot of span.

Let δ = deflection in inches, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of beams simply supported.

STEEL JOISTS.

Dimensions and Properties.



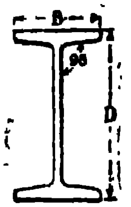
Size, D × B inches.	Weight per foot in lbs.	Area in square inches	Standard Thicknesses.		Moments of Inertia.		Maximum Modulus of Section. X - X	Safe Distributed Load on 1 foot Span.	Deflection Coefficient. X—X
			Web	Flange	Maximum. X X	Minimum. Y—Y			
24 × 7½	100	29·392	·600	1·070	2654·7	66·8	221·2	1106·1	·000781
20 × 7½	89	26·164	·600	1·010	1671·2	62·5	167·1	835·6	·000937
18 × 7	75	22·066	·550	·928	1149·6	46·6	127·7	638·7	·001041
16 × 6	62	18·227	·550	·847	725·9	27·0	90·7	453·7	·001172
15 × 6	59	17·346	·500	·880	629·0	28·2	83·8	419·4	·001250
15 × 5	42	12·351	·420	·647	428·2	11·9	57·1	285·4	·001250
14 × 6*a*	57	16·769	·500	·873	533·0	27·9	76·1	380·7	·001339
14 × 6*b*	46	13·533	·400	·698	440·6	21·5	62·9	314·7	·001339
12 × 6*a*	54	15·879	·500	·883	375·5	28·2	62·6	313·0	·001563
12 × 6*b*	44	12·946	·400	·717	315·4	22·2	52·5	262·8	·001563
12 × 5	32	9·408	·350	550	220·1	9·7	36·6	183·4	·001563
10 × 8	70	20·582	·600	·970	345·0	71·6	69·0	345·0	·001875
10 × 6	42	12·358	·400	·736	211·6	22·9	42·3	211·6	·001875
10 × 5	30	8·820	·360	·552	145·6	9·7	29·1	145·6	·001875
9 × 7	58	17·064	·550	·924	229·7	46·2	51·0	255·2	·002083

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



STEEL JOISTS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		3	4	5	6	7	8	9	10	11	12	14	16	18	20
BSB 15	9 × 4				15·0	12·8	11·2	10·1	9·0	8·2	7·5	6·4	5·6	5·0	4·5
BSB 14	8 × 6			27·3	23·0	19·7	17·3	15·3	13·8	12·6	11·5	9·8	8·6	7·7	6·9
BSB 13	8 × 5				18·6	15·9	14·0	12·4	11·2	10·1	9·3	7·9	7·0	6·2	5·7
BSB 12	8 × 4		17·4	13·9	11·6	9·9	8·6	7·7	6·9	6·3	5·8	4·9	4·3	3·8	3·4
BSB 11	7 × 4			11·2	9·3	8·0	7·0	6·2	5·6	5·1	4·6	4·0	3·5	3·1	
BSB 10	6 × 5		18·2	14·5	12·1	10·3	9·0	8·1	7·2	6·6	6·0	5·1	4·5		
BSB 9	6 × 4½		14·4	11·5	9·6	8·2	7·2	6·4	5·8	5·2	4·8	4·1	3·6		
BSB 8	6 × 3	11·2	8·4	6·7	5·6	4·8	4·2	3·7	3·3	3·0	2·8	2·4	2·1		
BSB 7	5 × 4½			9·0	7·6	6·4	5·6	5·0	4·5	4·1	3·8				
BSB 6	5 × 3		6·8	5·4	4·5	3·9	3·4	3·0	2·7	2·4	2·2				
BSB 5	4¾ × 1¾	4·7	3·5	2·8	2·4	2·0	1·8	1·5	1·4	1·3	1·2				
BSB 4	4 × 3	6·2	4·7	3·7	3·1	2·5	2·3	2·1	1·9						
BSB 3	4 × 1¾	3·0	2·3	1·8	1·5	1·3	1·1	1·0	0·9						
BSB 2	3 × 3	4·2	3·1	2·5	2·1	1·8	1·6								
BSB 1	3 × 1½	1·8	1·4	1·1	0·9	0·8	0·7								

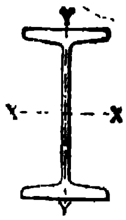
Tabular loads to right of zigzag line will produce deflection greater than 1/20th of an inch per foot of span.

Let δ = deflection in inches, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of beams simply supported.

STEEL JOISTS.

Dimensions and Properties.



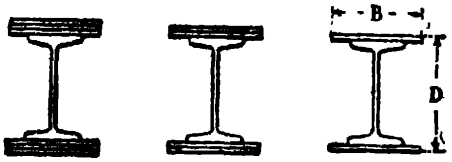
Size, D × B inches.	Weight per foot in lbs.	Area in square inches.	Standard Thicknesses.		Moments of Inertia.		Maximum Modulus of Section. X–X	Safe Distributed Load on 1 foot Span.	Deflection Coefficient. X—X
			Web.	Flange	Maximum. X–X	Minimum. Y–Y			
9 × 4	21	6·178	·300	·460	81·1	4·2	18·0	90·1	·002083
8 × 6	35	10·293	·440	·597	110·5	17·9	27·6	138·2	·002344
8 × 5	28	8·241	·350	·575	89·3	10·2	22·3	111·7	·002344
8 × 4	18	5·297	·280	·402	55·7	3·5	13·9	69·6	·002344
7 × 4	16	4·709	·250	·387	39·2	3·4	11·2	56·0	·002679
6 × 5	25	7·354	·410	·520	43·6	9·1	14·5	72·7	·003125
6 × 4½	20	5·882	·370	·431	34·6	5·4	11·5	57·7	·003125
6 × 3	12	3·527	·260	·348	20·2	1·3	6·7	33·8	·003125
5 × 4½	18	5·290	·290	·448	22·6	5·6	9·1	45·4	·003750
5 × 3	11	3·238	·220	·376	13·6	1·4	5·4	27·2	·003750
4¾ × 1¾	6½	1·912	·180	·325	6·7	0·26	2·8	14·2	·003947
4 × 3	9½	2·795	·220	·336	7·5	1·3	3·7	18·8	·004688
4 × 1¾	5	1·472	·170	·240	3·6	0·19	1·8	9·1	·004688
3 × 3	8½	2·501	·200	·332	3·7	1·2	2·5	12·6	·006250
3 × 1½	4	1·176	·160	·248	1·6	0·12	1·1	5·5	·006250

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV



COMPOUND GIRDERS.

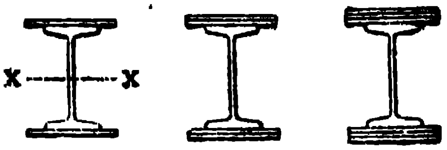
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		14	16	18	20	22	24	26	28	30	32	34	36	40	44
296A	29 × 12												*116*	*104*	*95·1*
294A	28½ × "											*113*	*107*	*96·4*	87·6
292A	28 × "			Rivets ⅞-in diameter.						*117*	*110*	*103*	*98·1*	88·3	80·2
290A	27½ × "								*114*	*107*	*100*	94·4	89·1	80·2	72·9
288A	27 × "						*120*	*111*	103	96·3	90·3	84·9	80·2	72·2	65·6
286A	26½ × "					*116*	107	98·8	91·7	85·6	80·3	75·5	71·3	64·2	58·4
284A	26 × "			125	112	102	93·8	86·6	80·4	75·1	70·4	66·2	62·5	56·3	51·2
283A	25¾ × "		130	116	104	95·2	87·3	80·5	74·8	69·8	65·4	61·6	58·2	52·3	47·6
282A	25½ × "		121	107	96·8	88·0	80·7	74·5	69·2	64·5	60·5	56·9	53·8	48·4	44·0
281A	25¼ × "	127	111	98·9	89·0	80·9	74·2	68·4	63·6	59·3	55·6	52·3	49·4	44·5	40·4
280A	25 × "	115	101	90·1	81·1	73·8	67·6	62·4	58·0	54·1	50·7	47·7	45·1	40·6	36·9
276A	25 × 12											*100*	*94·8*	*85·3*	*77·6*
274A	24½ × "										*98·0*	*92·3*	*87·1*	*78·4*	71·3
272A	24 × "			Rivets ⅞-in. diameter.					*102*	*95·4*	*89·5*	*84·2*	*79·5*	71·6	65·1
270A	23½ × "							*99·7*	*92·6*	*86·4*	*81·0*	76·2	72·0	64·8	58·9
268A	23 × "					*105*	*96·9*	*89·4*	83·0	77·5	72·6	68·3	64·5	58·1	52·8
266A	22½ × "				*102*	*93·5*	85·8	79·2	73·5	68·6	64·3	60·5	57·2	51·4	46·8
264A	22 × "		*112*	99·6	89·7	81·5	74·7	69·0	64·0	59·8	56·0	52·7	49·8	44·8	40·7
263A	21¾ × "		103	92·3	83·1	75·5	69·2	63·9	59·3	55·4	51·9	48·9	46·1	41·5	37·8
262A	21½ × "	109	95·7	85·0	76·5	69·6	63·8	58·9	54·7	51·0	47·8	45·0	42·5	38·3	34·8
261A	21¼ × "	100	87·5	77·8	70·0	63·6	58·3	53·9	50·0	46·7	43·8	41·2	38·9	35·0	31·8
260A	21 × "	90·7	79·4	70·6	63·5	57·7	52·9	48·9	45·4	42·3	39·7	37·4	35·3	31·7	28·8

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 50.
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



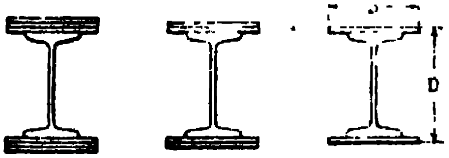
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
One Steel Joist.	Plates, each Flange to form.					Girder.	1 in Plate Width.	
24 × 7½	12 × 2½	308	89·4	12137	837·0	4185	303·5	·000646
"	" × 2¼	287½	83·4	10994	771·5	3857	272·5	·000658
"	" × 2	267	77·4	9891	706·5	3532	242·0	·000670
"	" × 1¾	246½	71·4	8826	641·9	3209	211·0	·000682
"	" × 1½	226	65·4	7799	577·7	2888	180·5	·000694
"	" × 1¼	206	59·4	6810	513·9	2569	150·5	·000708
"	" × 1	185½	53·4	5857	450·5	2252	120·0	·000721
"	" × ⅞	175	50·4	5394	418·9	2094	105·0	·000728
"	" × ¾	165	47·4	4940	387·4	1937	90·0	000735
"	" × ⅝	155	44·4	4495	356·0	1780	75·0	·000743
"	" × ½	144½	41·4	4058	324·6	1623	60·0	·000750
20 × 7½	12 × 2½	297	86·2	8534	682·8	3414	254·0	·000750
"	" × 2¼	276½	80·2	7687	627·5	3137	228·0	·000765
"	" × 2	256	74·2	6874	572·8	2864	202·0	·000781
"	" × 1¾	235½	68·2	6094	518·6	2593	176·5	·000798
"	" × 1½	215	62·2	5347	464·9	2324	151·0	·000815
"	" × 1¼	195	56·2	4631	411·6	2058	125·5	·000833
"	" × 1	174½	50·2	3946	358·7	1793	100·0	·000852
"	" × ⅞	164	47·2	3615	332·4	1662	87·5	·000862
"	" × ¾	154	44·2	3292	306·2	1531	75·0	·000872
"	" × ⅝	144	41·2	2976	280·1	1400	62·5	·000880
"	" × ½	133½	38·2	2668	254·1	1270	50·0	·000893

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

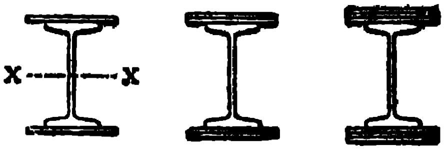
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET. 14	16	18	20	22	24	26	28	30	32	34	36	40	44
256A	23 × 12											*87·8*	*82·9*	*74·6*	*67·8*
254A	22½ × 〃											*80·3*	*75·9*	*68·3*	*62·1*
252A	22 × 〃	Rivets ⅞-in. diameter.								*82·8*	*77·6*	*73·0*	*69·0*	62·1	56·4
250A	21½ × 〃							*86·0*	*79·9*	*74·6*	*69·9*	65·8	62·1	55·9	50·8
248A	21 × 〃						*83·0*	*76·7*	*71·2*	66·4	62·3	58·6	55·3	49·8	45·3
246A	20½ × 〃				*87·5*	*79·6*	72·9	67·3	62·5	58·4	54·7	51·5	48·6	43·8	39·8
244A	20 × 〃			84·0	75·6	68·7	63·0	58·1	54·0	50·4	47·2	44·4	42·0	37·8	34·4
243A	19¾ × 〃		87·0	77·3	69·6	63·3	58·0	53·5	49·7	46·4	43·5	40·9	38·7	34·8	31·7
242A	19½ × 〃	91·0	79·6	70·8	63·7	57·9	53·1	49·0	45·5	42·4	39·8	37·4	35·4	31·8	28·9
241A	19¼ × 〃	82·5	72·2	64·2	57·8	52·5	48·1	44·4	41·3	38·5	36·1	34·0	32·1	28·9	26·3
240A	19 × 〃	74·1	64·8	57·6	51·9	47·1	43·2	39·9	37·0	34·5	32·4	30·5	28·8	25·9	23·5
		Rivets ⅞-in. diameter.													
232A	20 × 10						*75·8*	*69·9*	*64·9*	*60·6*	*56·8*	*53·5*	*50·5*	*45·5*	*41·3*
230A	19½ × 〃				*81·8*	*74·4*	*68·2*	*63·0*	*58·4*	*54·5*	*51·1*	*48·1*	*45·4*	40·9	37·1
228A	19 × 〃			*80·8*	*72·7*	*66·1*	*60·6*	*55·9*	*51·0*	*48·5*	*45·4*	42·8	40·4	36·4	33·0
226A	18½ × 〃		*79·7*	*70·9*	*63·8*	*58·0*	*53·1*	*49·1*	45·5	42·5	39·8	37·5	35·4	31·9	28·9
224A	18 × 〃	*78·4*	*68·6*	*61·0*	*54·9*	49·9	45·8	42·2	39·2	36·6	34·3	32·3	30·5	27·4	24·9
223A	17¾ × 〃	*72·2*	*63·2*	56·1	50·5	45·9	42·1	38·9	36·1	33·7	31·6	29·7	28·1	25·3	
222A	17½ × 〃	*65·9*	57·7	51·3	46·1	41·9	38·5	35·5	33·0	30·8	28·8	27·1	25·6	23·0	
221A	17¼ × 〃	59·7	52·2	46·4	41·8	38·0	34·8	32·1	29·8	27·9	26·1	24·6	23·2	20·9	
220A	17 × 〃	53·5	46·8	41·6	37·4	34·0	31·2	28·8	26·7	25·0	23·4	22·0	20·8	18·7	
		Rivets ¾-in. diameter.													
212A	19 × 10							*65·3*	*60·6*	*56·6*	*53·1*	*49·9*	*47·1*	*42·4*	38·5
210A	18½ × 〃						*63·6*	*58·7*	*54·5*	*50·8*	*47·7*	*44·9*	*42·4*	38·1	34·6
208A	18 × 〃				*67·8*	*61·6*	*56·5*	*52·1*	*48·4*	*45·2*	*42·3*	39·9	37·6	33·9	30·8
206A	17½ × 〃			*66·0*	*59·4*	*54·0*	*49·5*	*45·7*	42·4	39·6	37·1	34·9	33·0	29·7	
204A	17 × 〃	*73·0*	*63·8*	*56·7*	*51·1*	46·4	42·6	39·3	36·5	34·0	31·9	30·0	28·4	25·5	
203A	16¾ × 〃	*67·1*	*58·7*	52·2	46·9	42·7	39·1	36·1	33·5	31·3	29·3	27·6	26·1		
202A	16½ × 〃	*61·2*	53·6	47·6	42·8	38·9	35·7	32·9	30·6	28·6	26·8	25·2	23·8		
201A	16¼ × 〃	55·4	48·5	43·1	38·8	35·2	32·3	29·8	27·7	25·8	24·2	22·8	21·5		
200A	16 × 〃	49·6	43·4	38·6	34·7	31·6	28·9	26·7	24·8	23·1	21·7	20·4	19·3		

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 51.
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



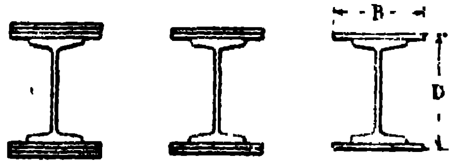
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
One Steel Joist.	Plates, each Flange to form.					Girder.	1 in Plate Width.	
18 × 7	12 × 2½	283	82·1	6865	**596·9**	2984	229·5	·000815
"	" × 2¼	262½	76·1	6149	**546·5**	2732	206·0	·000833
"	" × 2	242	70·1	5464	**496·8**	2484	182·5	·000852
"	" × 1¾	221½	64·1	4810	**447·4**	2237	159·0	·000872
"	" × 1½	201	58·1	4186	**398·6**	1993	136·0	·000893
"	" × 1¼	181	52·1	3590	**350·2**	1751	113·0	·000915
"	" × 1	160½	46·1	3023	**302·3**	1511	90·0	·000938
"	" × ⅞	150	43·1	2750	**278·4**	1392	79·0	·000950
"	" × ¾	140	40·1	2481	**254·7**	1273	67·5	·000961
"	" × ⅝	130	37·1	2224	**231·1**	1155	56·0	·000974
"	" × ½	119½	34·1	1971	**207·5**	1037	45·0	·000987
16 × 6	10 × 2	200½	58·2	3637	**363·7**	1818	162·5	·000938
"	" × 1¾	183½	53·2	3189	**327·1**	1635	141·5	·000961
"	" × 1½	166½	48·2	2763	**290·9**	1454	121·0	·000987
"	" × 1¼	149½	43·2	2360	**255·1**	1275	100·5	·001013
"	" × 1	132½	38·2	1977	**219·7**	1098	80·5	·001041
"	" × ⅞	124	35·7	1794	**202·1**	1010	70·0	·001056
"	" × ¾	115½	33·2	1615	**184·6**	923	60·0	·001071
"	" × ⅝	107	30·7	1442	**167·2**	836	50·0	·001087
"	" × ½	98½	28·2	1273	**149·8**	749	40·0	·001103
15 × 6	10 × 2	197½	57·3	3226	**339·6**	1698	152·5	·000987
"	" × 1¾	180½	52·3	2822	**305·1**	1525	133·0	·001013
"	" × 1½	163½	47·3	2440	**271·1**	1355	113·5	·001041
"	" × 1¼	146½	42·3	2078	**237·5**	1187	94·5	·001071
"	" × 1	129½	37·3	1736	**204·3**	1021	75·5	·001103
"	" × ⅞	121	34·8	1573	**187·8**	939	66·0	·001119
"	" × ¾	112½	32·3	1414	**171·4**	857	56·5	·001136
"	" × ⅝	101	29·8	1260	**155·1**	775	47·0	·001151
"	" × ½	95½	27·3	1111	**138·9**	694	37·5	·001172

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$

For full explanations of tables see notes commencing page 108

For formulæ, explanations of properties, &c., see Part IV



COMPOUND GIRDERS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		10	12	14	16	18	20	22	24	26	28	30	32	34	36
188A	18 × 9		Rivets ⅞-in. diameter.				*56·9*	*51·7*	*47·4*	*43·8*	*40·6*	*37·9*	35·6	33·5	31·6
186A	17½ × ″					*54·9*	*49·4*	*44·9*	*41·1*	38·0	35·2	32·9	30·9	29·0	27·4
184A	17 × ″			*59·8*	*52·3*	*46·5*	41·9	38·1	34·9	32·2	29·9	27·9	26·2	24·6	23·2
183A	16¾ × ″		*63·6*	*54·5*	*47·7*	42·4	38·1	34·7	31·8	29·3	27·2	25·4	23·8	22·4	21·2
182A	16½ × ″		*57·4*	49·2	43·0	38·2	34·4	31·3	28·7	26·5	24·6	22·9	21·5	20·2	19·1
181A	16¼ × ″	*61·5*	51·2	43·9	38·4	34·1	30·7	27·9	25·6	23·6	22·0	20·5	19·2	18·1	17·1
180A	16 × ″	54·1	45·1	38·7	33·8	30·1	27·1	24·6	22·6	20·8	19·3	18·0	16·9	15·9	15·0
179A	15¾ × ″	46·8	39·0	33·4	29·2	26·0	23·4	21·3	19·5	18·0	16·7	15·6	14·6	13·7	
172A	18 × 10									*60·6*	*56·3*	*52·5*	*49·2*	*46·3*	*43·8*
170A	17½ × ″								*58·9*	*54·4*	*50·5*	*47·1*	*44·2*	*41·6*	*39·3*
168A	17 × ″		Rivets ⅞-in. diameter.				*62·7*	*57·0*	*52·3*	*48·3*	*44·8*	*41·8*	*39·2*	36·9	34·8
166A	16½ × ″					*61·0*	*54·9*	*49·9*	*45·7*	*42·2*	39·2	36·6	34·3	32·3	30·5
164A	16 × ″			*67·3*	*58·9*	*52·4*	*47·1*	42·8	39·3	36·3	33·7	31·4	29·4	27·7	26·2
163A	15¾ × ″		*72·1*	*61·8*	*54·1*	48·1	43·3	39·3	36·1	33·3	30·9	28·8	27·0	25·5	
162A	15½ × ″		*65·8*	*56·4*	49·3	43·8	39·4	35·9	32·9	30·3	28·2	26·3	24·6	23·2	
161A	15¼ × ″	*71·3*	59·4	50·9	44·6	39·6	35·6	32·4	29·7	27·4	25·5	23·8	22·3	21·0	
160A	15 × ″	63·7	53·1	45·5	39·8	35·4	31·8	28·9	26·5	24·5	22·7	21·2	19·9	18·7	
159A	14¾ × ″	56·2	46·8	40·1	35·1	31·2	28·1	25·5	23·4	21·6	20·1	18·7	17·5		
148A	17 × 10		Rivets ¾-in. diameter.							*46·4*	*43·1*	*40·2*	*37·7*	35·5	33·5
146A	16½ × ″							*47·7*	*43·7*	*40·3*	37·4	34·9	32·8	30·8	29·1
144A	16 × ″					*49·5*	*44·6*	40·5	37·1	34·3	31·8	29·7	27·8	26·2	24·8
143A	15¾ × ″				*50·8*	*45·2*	40·7	37·0	33·9	31·3	29·0	27·1	25·4	23·9	
142A	15½ × ″			*52·6*	46·0	40·9	36·8	33·5	30·7	28·3	26·3	24·5	23·0	21·7	
141A	15¼ × ″		*55·0*	47·1	41·2	36·6	33·0	30·0	27·5	25·4	23·5	22·0	20·6	19·4	
140A	15 × ″		48·6	41·6	36·4	32·4	29·1	26·5	24·3	22·4	20·8	19·4	18·2	17·1	
139A	14¾ × ″	50·7	42·2	36·2	31·7	28·2	25·3	23·0	21·1	19·5	18·1	16·9	15·8		

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span

Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling

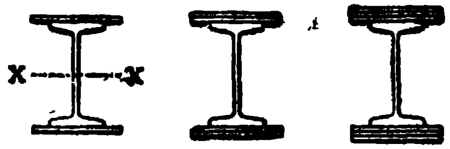
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch

Girders supporting tabular loads printed in italics require a closer pitch of rivets See page 51

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4 Ends of girders simply supported

COMPOUND GIRDERS.

Composition and Properties.



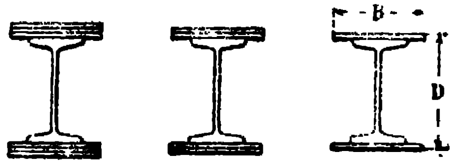
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
One Steel Joist.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
15 × 5	9 × 1½	136½	39·4	2050	227·8	1139	113·5	·001041
"	" × 1¼	121	34·9	1728	197·5	987	94·5	·001071
"	" × 1	105½	30·4	1423	167·5	837	75·5	·001103
"	" × ⅞	98	28·1	1278	152·6	763	66·0	·001119
"	" × ¾	90½	25·9	1136	137·7	688	56·5	·001136
"	" × ⅝	82½	23·6	999	123·0	615	47·0	·001151
"	" × ½	75	21·4	866	108·3	541	37·5	·001172
"	" × ⅜	67½	19·1	737	93·6	468	28·0	·001190
14 × 6*a*	10 × 2	195½	56·8	2837	315·2	1576	143·0	·001041
"	" × 1¾	178½	51·8	2475	282·9	1414	124·5	·001071
"	" × 1½	161½	46·8	2133	251·0	1255	106·0	·001103
"	" × 1¼	144½	41·8	1811	219·5	1097	88·0	·001136
"	" × 1	127½	37·8	1508	188·5	942	70·5	·001172
"	" × ⅞	119	34·3	1363	173·1	865	61·5	·001190
"	" × ¾	110½	31·8	1223	157·8	789	52·5	·001210
"	" × ⅝	102	29·3	1087	142·6	713	44·0	·001230
"	" × ½	93½	26·8	956	127·4	637	35·0	·001250
"	" × ⅜	85	24·3	829	112·4	562	26·0	·001271
14 × 6*b*	10 × 1½	150½	43·5	2052	241·4	1207	106·0	·001103
"	" × 1¼	133½	38·5	1730	209·7	1048	88·0	·001136
"	" × 1	116½	33·5	1427	178·3	891	70·5	·001172
"	" × ⅞	108	31·0	1282	162·8	814	61·5	·001190
"	" × ¾	99½	28·5	1142	147·3	736	52·5	·001210
"	" × ⅝	91	26·0	1006	131·9	659	44·0	·001230
"	" × ½	82½	23·5	875	116·6	583	35·0	·001250
"	" × ⅜	74	21·0	748	101·4	507	26·0	·001271

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.

For full explanation of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

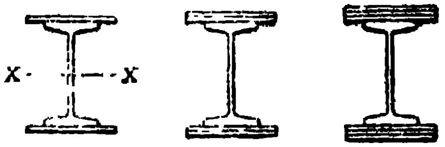
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	8	10	12	14	16	18	20	22	24	26	28	30	32	34
		SPANS IN FEET.													
132A	16 × 10										*51·6*	*47·9*	*44·7*	*41·9*	*39·4*
130A	15½ × "								*54·5*	*50·0*	*46·2*	*42·9*	*40·0*	*37·5*	*35·3*
128A	15 × "		Rivets ⅞ in. diameter.					*53·1*	*48·3*	*44·2*	*40·8*	*37·0*	*35·4*	*33·2*	31·2
126A	14½ × "					*55·1*	*51·6*	*46·4*	*42·2*	*38·7*	*35·7*	33·2	31·0	29·0	
124A	14 × "				*56·6*	*49·5*	*44·0*	[illegible]	36·0	33·0	30·5	28·3	26·4	24·8	
123A	13¾ × "			*60·5*	*51·9*	*45·4*	40·3	36·3	33·0	30·3	27·9	25·9	24·2		
122A	13½ × "			*55·1*	*47·2*	41·3	36·7	33·0	30·0	27·5	25·4	23·6	22·0		
121A	13¼ × "		*59·6*	49·7	42·6	37·2	33·1	29·8	27·1	24·8	22·9	21·3	19·9		
120A	13 × "	*66·4*	53·1	44·3	38·0	33·2	29·5	26·6	24·2	22·1	20·4	19·0	17·7		
119A	12¾ × "	58·4	46·7	38·9	33·3	29·2	25·9	23·3	21·2	19·5	18·0	16·7			
108A	15 × 10										*39·5*	*36·7*	*34·2*	*32·1*	30·2
106A	14½ × "		Rivets ¾-in. diameter.						*40·6*	*37·2*	*34·3*	31·9	29·8	27·9	
104A	14 × "						*41·9*	*37·7*	34·3	31·4	29·0	26·9	25·2	23·6	
103A	13¾ × "					*43·0*	*38·2*	34·4	31·3	28·7	26·5	24·6	22·9		
102A	13½ × "				*44·4*	38·9	34·5	31·1	28·3	25·9	23·9	22·2	20·7		
101A	13¼ × "			*46·4*	39·7	34·8	30·9	27·8	25·3	23·2	21·4	19·9	18·5		
100A	13 × "		49·1	40·9	35·1	30·7	27·3	24·5	22·3	20·4	18·9	17·5	16·4		
99A	12¾ × "	53·2	42·6	35·5	30·4	26·6	23·7	21·3	19·3	17·7	16·4	15·2			
88A	15 × 9									*36·5*	*33·7*	*31·3*	*29·2*	27·4	25·8
86A	14½ × "		Rivets ¾-in. diameter					*37·8*	*34·3*	*31·5*	29·1	27·0	25·2	23·6	
84A	14 × "					*39·5*	*35·1*	31·6	28·7	26·3	24·3	22·5	21·0	19·7	
83A	13¾ × "					*35·7*	31·7	28·6	26·0	23·8	22·0	20·4	19·0		
82A	13½ × "				*36·5*	32·0	28·4	25·6	23·2	21·3	19·7	18·3	17·0		
81A	13¼ × "			37·7	32·3	28·2	25·1	22·6	20·5	18·8	17·4	16·1	15·1		
80A	13 × "		39·3	32·7	28·1	24·6	21·8	19·6	17·9	16·4	15·1	14·0	13·1		
79A	12¾ × "	41·7	33·4	27·8	23·8	20·9	18·5	16·7	15·2	13·9	12·8	11·9			

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 52
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. ***Ends of girders simply supported.***

COMPOUND GIRDERS.

Composition and Properties.



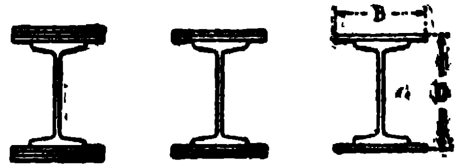
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X - X	Maximum Modulus of Section. X X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
One Steel Joist.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
12 × 6*a*	10 × 2	192½	55·9	2145	**268·1**	1340	123·0	·001172
"	" × 1¾	175½	50·9	1860	**240·0**	1200	107·0	·001210
"	" × 1½	158½	45·9	1593	**212·4**	1062	91·5	·001250
"	" × 1¼	141½	40·9	1347	**185·8**	929	76·0	·001293
"	" × 1	125	35·9	1110	**158·5**	792	60·5	·001339
"	" × ⅞	116	33·4	999	**145·3**	726	52·5	·001364
"	" × ¾	107½	30·9	892	**132·2**	661	45·0	·001389
"	" × ⅝	99	28·4	790	**119·2**	596	37·5	·001415
"	" × ½	90½	25·9	691	**106·3**	531	30·0	·001442
"	" × ⅜	82	23·4	596	**93·4**	467	22·5	·001471
12 × 6*b*	10 × 1½	148½	42·9	1540	**205·3**	1026	91·5	·001250
"	" × 1¼	131½	37·9	1294	**178·6**	893	76·0	·001293
"	" × 1	114½	32·9	1057	**151·0**	755	60·5	·001339
"	" × ⅞	106	30·4	916	**137·7**	688	52·5	·001364
"	" × ¾	97½	27·9	840	**124·4**	622	45·0	·001389
"	" × ⅝	89	25·4	737	**111·3**	556	37·5	·001415
"	" × ½	80½	22·9	638	**98·2**	491	30·0	·001442
"	" × ⅜	72	20·4	543	**85·2**	426	22·5	·001471
12 × 5	9 × 1½	126½	36·4	1315	**175·3**	876	91·5	·001250
"	" × 1¼	111	31·9	1096	**151·2**	756	76·0	·001293
"	" × 1	95½	27·4	884	**126·3**	631	60·5	·001339
"	" × ⅞	88	25·2	785	**114·3**	571	52·5	·001364
"	" × ¾	80½	22·9	690	**102·3**	511	45·0	·001389
"	" × ⅝	72½	20·7	599	**90·4**	452	37·5	·001415
"	" × ½	65	18·4	511	**78·6**	393	30·0	·001442
"	" × ⅜	57½	16·2	426	**66·8**	334	22·5	·001471

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

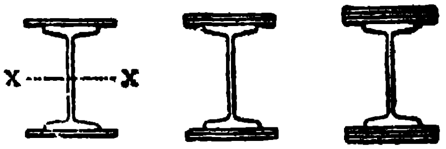
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.												
		6	8	10	12	14	16	18	20	22	24	26	28	30
68A	13 × 10										*35·3*	*32·6*	*30·3*	*28·3*
66A	12½ × "		Rivets ¾ in. diameter.							*33·3*	*30·5*	*28·2*	26·2	
64A	12 × "							*34·4*	*31·0*	28·2	25·8	23·8	22·1	
63A	11¾ × "						*35·2*	*31·3*	28·2	25·6	23·5	21·7		
62A	11½ × "					*36·3*	31·8	28·3	25·4	23·1	21·2	19·6		
61A	11¼ × "				*37·8*	32·4	28·4	25·2	22·7	20·6	18·9	17·5		
60A	11 × "			40·0	33·3	28·6	25·0	22·2	20·0	18·2	16·7	15·4		
59A	10¾ × "		43·2	34·6	28·8	24·7	21·6	19·2	17·3	15·7	14·4			
48A	13 × 9										*30·2*	*27·9*	*25·9*	*24·2*
46A	12½ × "		Rivets ¾-in. diameter.						*31·0*	*28·2*	*25·9*	23·9	22·2	
44A	12 × "						*32·4*	*28·8*	25·9	23·6	21·6	20·0	18·5	
43A	11¾ × "					*33·4*	*29·3*	26·0	23·4	21·3	19·5	18·0		
42A	11½ × "				*34·9*	*29·9*	26·1	23·2	20·9	19·0	17·4	16·1		
41A	11¼ × "			*36·9*	30·7	26·4	23·1	20·5	18·4	16·8	15·4	14·2		
40A	11 × "		*40·0*	31·9	26·6	22·8	20·0	17·7	16·0	14·5	13·3	12·3		
39A	10¾ × "	*45·1*	33·9	27·1	22·6	19·3	16·9	15·0	13·5	12·3	11·3			
28A	11 × 10								*32·9*	*29·9*	*27·4*	*25·3*		
26A	10½ × "							*31·3*	*28·2*	*25·6*	*23·5*			
24A	10 × "					*33·6*	*29·4*	*26·2*	*23·5*	21·4	19·6			
23A	9¾ × "				*35·5*	*30·4*	*26·6*	*23·7*	21·3	19·4				
22A	9½ × "			*38·1*	*31·7*	*27·2*	23·8	21·2	19·0	17·3		Rivets ¾-in. diameter.		
21A	9¼ × "			*33·7*	*28·1*	24·1	21·1	18·7	16·8	15·3				
20A	9 × "		*36·6*	29·3	24·4	20·9	18·3	16·3	14·6	13·3				
19A	8¾ × "	*41·6*	31·2	24·9	20·8	17·8	15·6	13·8	12·5					
14A	10 × 9						*25·6*	*22·7*	20·5	18·6	17·1			
13A	9¾ × "					*26·3*	*23·0*	20·5	18·4	16·7				
12A	9½ × "				*27·4*	*23·5*	20·5	18·2	16·4	14·9				
11A	9¼ × "			*28·9*	24·1	20·6	18·1	16·0	14·4	13·1				
10A	9 × "		*31·2*	24·9	20·8	17·8	15·6	13·8	12·5	11·3		Rivets ¾-in. diameter.		
9A	8¾ × "	*35·1*	26·3	21·0	17·5	15·0	13·1	11·7	10·5					

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 52
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4 Ends of girders simply supported

COMPOUND GIRDERS.

Composition and Properties.



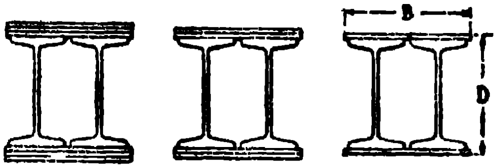
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. x—x	Maximum Modulus of Section. x—x	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. x—x
One Steel Joist.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
10 × 6	10 × 1½	146½	42·4	1103	169·6	848	76·5	·001442
"	" × 1¼	129½	37·4	916	146·6	733	63·5	·001500
"	" × 1	112½	32·4	744	124·0	620	50·5	·001563
"	" × ⅞	104	29·9	663	112·8	564	44·0	·001596
"	" × ¾	95½	27·4	585	101·8	509	37·5	·001630
"	" × ⅝	87	24·9	511	90·8	454	31·5	·001667
"	" × ½	78½	22·4	440	80·0	400	25·0	·001704
"	" × ⅜	70	19·9	372	69·2	346	18·5	·001744
10 × 5	9 × 1½	124½	35·8	942	145·0	725	76·5	·001442
"	" × 1¼	109	31·3	776	124·2	621	63·5	·001500
"	" × 1	93½	26·8	622	103·8	519	50·5	·001563
"	" × ⅞	86	24·6	550	93·7	468	44·0	·001596
"	" × ¾	78½	22·3	481	83·7	418	37·5	·001630
"	" × ⅝	70½	20·1	415	73·8	369	31·5	·001667
"	" × ½	63	17·8	351	63·9	319	25·0	·001704
"	" × ⅜	55½	15·6	291	54·2	271	18·5	·001744
8 × 6	10 × 1½	139½	40·3	724	131·7	659	62·0	·001704
"	" × 1¼	122½	35·3	592	112·7	563	51·0	·001785
"	" × 1	105½	30·3	471	94·2	471	40·5	·001875
"	" × ⅞	97	27·8	415	85·2	426	35·5	·001923
"	" × ¾	88½	25·3	362	76·2	381	30·0	·001974
"	" × ⅝	80	22·8	311	67·4	337	25·0	·002027
"	" × ½	71½	20·3	263	58·6	293	20·0	·002083
"	" × ⅜	63	17·8	218	49·9	249	15·0	·002143
8 × 5	9 × 1	91½	26·2	409	81·9	409	40·5	·001875
"	" × ⅞	83½	24·0	359	73·7	368	35·5	·001923
"	" × ¾	76½	21·7	312	65·7	328	30·0	·001974
"	" × ⅝	69	19·5	267	57·8	289	25·0	·002027
"	" × ½	61	17·2	224	49·9	249	20·0	·002083
"	" × ⅜	53½	15·0	184	42·1	210	15·0	·002143

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

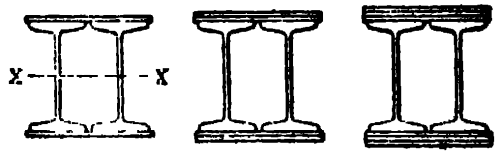
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		14	16	18	20	22	24	26	28	30	32	34	36	40	44
296B	29 × 16									*198*	*185*	*174*	*165*	*148*	*135*
294B	28½ × „		Rivets ⅞-in. diameter.						*197*	*184*	*172*	*162*	*153*	*138*	*125*
292B	28 × „						*213*	*197*	*183*	*171*	*160*	*150*	*142*	*128*	*116*
290B	27½ × „				*230*	*214*	*197*	*181*	*168*	*157*	*147*	*134*	*131*	118	107
288B	27 × „			*249*	*216*	*196*	*180*	*16[illegible]*	*154*	*14[illegible]*	*13[illegible]*	127	120	108	98·4
286B	26½ × „		*246*	*218*	*196*	*178*	*164*	*151*	140	131	123	115	109	98·4	89·4
284B	26 × „	*254*	*221*	*196*	177	161	147	136	126	118	110	104	98·4	88·6	80·5
283B	25¾ × „	*23[illegible]*	*209*	186	167	152	139	128	119	111	104	98·[illegible]	[illegible]·0	83·7	76·1
282B	25½ × „	225	197	175	157	143	131	121	112	105	98·5	92·7	87·0	78·8	71·7
281B	25¼ × „	211	185	164	148	134	123	113	105	[illegible]·6	92·5	87·0	82·2	74·0	67·3
280B	25 × „	197	172	153	138	125	115	106	98·8	92·2	86·5	81·3	7[illegible]	69·1	62·9
276B	25 × 16		Rivets ⅞-in. diameter.							*159*	*14[illegible]*	*141*	*133*	*119*	*109*
274B	24½ × „								*158*	*148*	*13[illegible]*	*130*	*123*	*111*	*101*
272B	24 × „						*171*	*158*	*146*	*137*	*128*	*120*	*114*	*102*	*93·4*
270B	23½ × „				*188*	*171*	*157*	*145*	*134*	*125*	*117*	*111*	*104*	*94·3*	85·8
268B	23 × „			*191*	*172*	*156*	*143*	*132*	*122*	*114*	*107*	101	95·6	86·0	78·2
266B	22½ × „	*222*	*194*	*172*	*155*	*141*	*129*	*119*	111	103	97·2	91·5	86·4	77·8	70·7
264B	22 × „	*198*	*174*	*154*	*139*	126	116	107	99·4	92·8	87·0	81·9	77·3	69·6	63·3
263B	21¾ × „	*187*	*163*	145	131	119	109	100	93·8	87·4	82·0	77·1	72·8	65·6	59·6
262B	21½ × „	175	153	136	123	111	102	94·7	87·9	82·0	76·9	72·4	68·3	61·5	55·9
261B	21¼ × „	164	143	127	115	104	95·8	88·5	82·1	76·7	71·9	67·6	63·9	57·5	52·3
260B	21 × „	152	133	118	107	97·3	89·2	82·3	76·4	71·4	66·9	62·9	59·4	53·5	48·6

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 53.
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



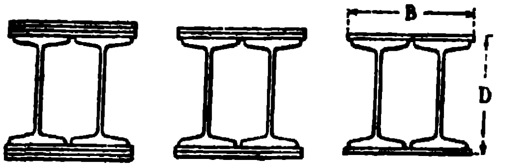
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Two Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
24 × 7½	16 × 2½	475½	138·7	17232	1188·4	5942	303·5	·000646
"	" × 2¼	448½	130·7	15772	1106·4	5534	272·5	·000658
"	" × 2	421½	122·7	14363	1025·9	5129	242·0	·000669
"	" × 1¾	394	114·7	13004	945·7	4728	211·0	·000681
"	" × 1½	367	106·7	11692	866·1	4330	180·5	·000694
"	" × 1¼	339½	98·7	10429	787·1	3935	150·5	·000707
"	" 1	312½	90·7	9212	708·6	3543	120·0	·000721
"	× ⅞	299	86·7	8621	669·6	3348	105·0	·000728
"	" × ¾	285½	82·7	8042	630·7	3153	90·0	·000735
"	" ⅝	[illegible]	78·7	7473	591·9	2959	75·0	·000742
"	× ½	258	74·7	6916	553·3	2766	60·0	·000750
20 × 7½	16 × 2½	453½	132·3	11986	958·9	4794	254·0	·000750
"	" × 2¼	426½	124·3	10904	890·1	4450	228·0	·000765
"	" × 2	399½	116·3	9866	822·2	4111	202·0	·000781
"	" × 1¾	372	108·3	8870	754·8	3774	176·5	·000797
"	" × 1½	345	100·3	7915	688·3	3441	151·0	·000815
"	" × 1¼	317½	92·3	7001	622·4	3112	125·5	·000833
"	" × 1	290½	84·3	6127	557·0	2785	100·0	·000852
"	" × ⅞	277	80·3	5705	524·6	2623	87·5	·000862
"	" × ¾	263½	76·3	5292	492·2	2461	75·0	·000872
"	" × ⅝	249½	72·3	4889	460·1	2300	62·5	·000880
"	" × ½	236	68·3	4495	428·1	2140	50·0	·000893

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then δ = K × L³.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

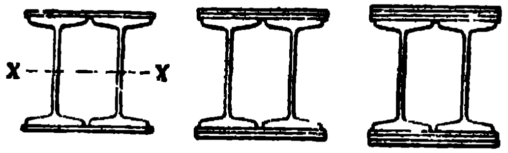
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET. 14	16	18	20	22	24	26	28	30	32	34	36	40	44
		Rivets ⅞-in. diameter.													
256B	23 × 16										*129*	*121*	*114*	*103*	*93·9*
254B	22½ × "								*136*	*127*	*119*	*112*	*106*	*95·4*	*86·8*
252B	22 × "						*140*	*134*	*125*	*116*	*109*	*103*	*97·4*	*87·7*	*79·7*
250B	21½ × "					*145*	*133*	*123*	*114*	*106*	*100*	*94·1*	*88·9*	*80·0*	72·8
248B	21 × "			*161*	*144*	*131*	*120*	*111*	*103*	*96·6*	*90·5*	*85·2*	80·5	72·4	65·8
246B	20½ × "	*185*	*162*	*144*	*129*	*118*	*108*	*99·9*	92·8	86·6	81·2	76·4	72·1	64·9	59·0
244B	20 × "	*164*	*143*	*127*	*115*	104	95·8	88·5	82·1	76·7	71·9	67·6	63 9	57·5	52·3
243B	19¾ × "	*153*	*134*	119	107	97·8	89·7	82·8	76·9	71·8	67·3	63·3	59·8	53·8	48·9
242B	19½ × "	*143*	125	111	100	91·2	83 6	77·2	71·6	66·9	62·7	59·0	55·7	50·1	45·6
241B	19¼ × "	132	116	103	93·0	84·5	77·5	71·6	66·4	62·0	58·1	54·7	51·7	46·5	42·3
240B	19 × "	122	107	95·3	85·7	77·9	71·4	66·0	61·2	57·2	53 6	50·4	47·6	42·9	38·9
		Rivets ¾-in diameter.													
232B	20 × 14									*88·7*	*83·1*	*78·2*	*73·9*	*66·5*	*60·5*
230B	19½ × "							*93·1*	*86·4*	*80·7*	*75·6*	*71·2*	*67·2*	*60·5*	*55·0*
228B	19 × "					*99·2*	*90·9*	*83·9*	*77·9*	*72·7*	*68·2*	*64·7*	*60·6*	*54·5*	49 6
226B	18½ × "			*108*	*97·3*	*88·5*	*81·1*	*74·9*	*69·5*	*64·9*	*60·8*	57·2	54·1	48·7	44·3
224B	18 × "	*122*	*107*	*95·2*	*85·7*	*77·9*	*71·4*	65·9	61·2	57·1	53·6	50·4	47·6	42·9	38 9
223B	17¾ × "	*114*	*99·9*	*88·8*	*80·0*	72·7	66·6	61·5	57·1	53·3	50·0	47·0	44·4	40·0	
222B	17½ × "	*106*	*92·8*	82·5	74·2	67·5	61·9	57·1	53 0	49·5	46·4	43·7	41·2	37·1	
221B	17¼ × "	98·0	85·7	76·2	68·6	62·3	57·1	52·7	49 0	45·7	42·9	40·3	38·1	34·3	
220B	17 × "	89·9	78·6	69·9	62·9	57·2	52·4	48·4	44·9	41·9	39·3	37·0	34·9	31·5	
		Rivets ⅞-in. diameter.													
212B	19 × 14									*82·6*	*77·5*	*72·9*	*68·9*	*62·0*	*56·4*
210B	18½ × "							*86·6*	*80·4*	*75·1*	*70·4*	*66·2*	*62·6*	*56·3*	*51·2*
208B	18 × "					*92·2*	*84·5*	*78·0*	*72·4*	*67·6*	*63·4*	*59·6*	*56·3*	*50·7*	46·1
206B	17½ × "			*100*	*90·4*	*82·2*	*75·3*	*69·3*	*64·6*	*60·3*	*56·5*	53·2	50·2	45·2	
204B	17 × "	*113*	*99·4*	*88·3*	*79·5*	*72·3*	*66·3*	61·2	56·8	53·0	49·7	46·8	44·2	36·1	
203B	16¾ × "	*105*	*92·7*	*82·4*	*74·1*	67·4	61·8	57·0	52·9	49·4	46·3	43·6	41·2		
202B	16½ × "	*98·3*	*86·0*	76·4	68·8	62·5	57·3	52·9	49·1	45·8	43·0	40·4	38·2		
201B	16¼ × "	90·6	79·3	70·5	63·4	57·7	52·9	48·8	45·3	42·3	39·6	37·3	35·2		
200B	16 × "	83·1	72·7	64·6	58·2	52·9	48·5	44·7	41·5	38·8	36·3	34·2	32·8		

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 54.
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported

COMPOUND GIRDERS.

Composition and Properties.



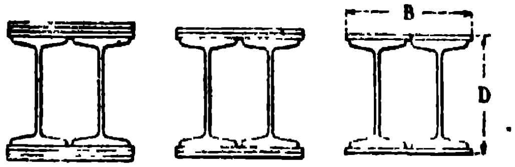
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Two teel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
18 × 7	16 × 2½	426	124·1	9506	826·6	4133	229·5	·000815
"	" × 2¼	398½	116·1	8592	763·7	3818	206·0	·000833
"	" × 2	371½	108·1	7718	701·6	3508	182·5	·000852
"	" × 1¾	344½	100·1	6883	640·3	3201	159·0	·000872
"	" × 1½	317	92·1	6085	579·6	2898	136·0	·000893
"	" × 1¼	290	84·1	5325	519·5	2597	113·0	·000914
"	" × 1	262½	76·1	4601	460·1	2300	90·0	·000937
"	" × ⅞	249	72·1	4252	430·6	2153	79·0	·000949
"	" × ¾	235½	68·1	3912	401·3	2006	67·5	·000961
"	" × ⅝	222	64·1	3581	372·0	1860	56·5	·000974
"	" × ½	208½	60·1	3258	343·0	1715	45·0	·000987
16 × 6	14 × 2	317	92·4	5322	532·2	2661	162·5	·000937
"	" × 1¾	293	85·4	4719	484·0	2420	141·5	·000961
"	" × 1½	269	78·4	4145	436·4	2182	121·0	·000987
"	" × 1¼	245½	71·4	3602	389·4	1947	100·5	·001013
"	" × 1	221½	64·4	3086	342·9	1714	80·5	·001041
"	" × ⅞	209½	60·9	2839	319·9	1599	70·0	·001056
"	" × ¾	198	57·4	2599	297·0	1485	60·0	·001071
"	" × ⅝	186	53·9	2366	274·3	1371	50·0	·001087
"	" × ½	174	50·4	2139	251·6	1258	40·0	·001103
15 × 6	14 × 2	311	90·6	4711	495·9	2479	152·5	·000987
"	" × 1¾	287	83·6	4167	450·5	2252	133·0	·001013
"	" × 1½	263½	76·6	3652	405·7	2028	113·5	·001041
"	" × 1¼	239½	69·6	3164	361·6	1808	94·5	·001071
"	" × 1	215½	62·6	2704	318·1	1590	75·5	·001103
"	" × ⅞	204	59·1	2484	296·5	1482	66·0	·001119
"	" × ¾	192	55·6	2270	275·1	1375	56·5	·001136
"	" × ⅝	180	52·1	2062	253·8	1269	47·0	·001151
"	" × ½	168	48·6	1861	232·7	1163	37·5	·001172

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

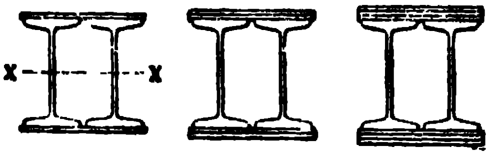
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		10	12	14	16	18	20	22	24	26	28	30	32	34	36
188B	18 × 12	Rivets ¾-in. diameter.					*79·8*	*72·5*	*66·5*	*61·4*	*57·0*	*53·2*	*49·9*	*46·9*	*44·3*
186B	17½ × ″				*88·0*	*78·2*	*70·4*	*64·0*	*58·7*	*54·1*	*50·3*	*46·9*	44·0	41·4	39·1
184B	17 × ″		*101*	*87·4*	*76·4*	*67·9*	*61·1*	*55·5*	50·9	47·0	43·7	40·7	38·2	35·9	33·9
183B	16¾ × ″	*113*	*94·2*	*80·8*	*70·7*	*62·8*	56·5	51·4	47·1	43·5	40·4	37·7	35·3	33·2	31·4
182B	16½ × ″	*103*	*86·6*	*74·2*	*64·9*	57·7	51·9	47·2	43·3	40·0	37·1	34·6	32·5	30·5	28·8
181B	16¼ × ″	*94·8*	*79·0*	67·7	59·2	52·6	47·4	43·1	39·5	36·5	33·8	31·6	29·6	27·9	26·3
180B	16 × ″	85·8	71·4	61·2	53·6	47·6	42·9	39·0	35·7	33·0	30·6	28·6	26·8	25·2	23·8
179B	15¾ × ″	76·7	63·9	54·8	17·9	42·6	38·3	34·9	31·9	24·5	27·4	25·6	24·0	22·5	
172B	18 × 14											*76·5*	*71·7*	*67·5*	*63·7*
170B	17½ × ″	Rivets ¾-in. diameter.								*80·1*	*74·3*	*69·4*	*65·0*	*61·2*	*57·8*
168B	17 × ″							*85·1*	*78·0*	*72·0*	*66·9*	*62·4*	*58·2*	*55·1*	*52·0*
166B	16½ × ″					*92·6*	*83·3*	*75·7*	*69·4*	*64·1*	*59·5*	*55·5*	*52·0*	49·0	46·2
164B	16 × ″			*104*	*91·4*	*81·2*	*73·1*	*66·5*	*60·9*	56·2	52·2	48·7	45·7	43·0	40·6
163B	15¾ × ″		*113*	*97·3*	*85·1*	*75·7*	*68·1*	61·9	56·8	52·4	48·6	45·4	42·6	40·1	
162B	15½ × ″	*126*	*105*	*90·2*	*78·9*	70·1	63·1	57·4	52·6	48·5	45·1	42·1	39·4	37·1	
161B	15¼ × ″	*116*	*96·9*	83·1	72·7	64·6	58·1	52·8	48·4	44·7	41·5	38·8	36·3	34·2	
160B	15 × ″	*106*	88·7	76·0	66·5	59·1	53·2	48·4	44·3	40·9	38·0	35·5	33·3	31·3	
159B	14¾ × ″	96·7	80·5	69·0	60·4	53·7	48·3	43·9	40·3	37·2	34·5	32·2	30·2		
148B	17 × 14	Rivets ¾-in. diameter.						*80·3*	*73·6*	*67·9*	*63·1*	*58·9*	*55·2*	*51·9*	*49·1*
146B	16½ × ″					*87·1*	*78·4*	*71·2*	*65·3*	*60·3*	*56·0*	*52·2*	*49·0*	*46·1*	43·5
144B	16 × ″			*97·2*	*85·1*	*75·6*	*68·0*	*61·9*	*56·7*	*52·4*	48·6	45·4	42·5	40·0	37·8
143B	15¾ × ″		*105*	*89·9*	*78·7*	*69·9*	*62·9*	*57·2*	52·5	48·4	45·0	42·0	39·3	37·0	
142B	15½ × ″	*115*	*96·5*	*82·7*	*72·4*	*64·3*	57·9	52·6	48·2	44·5	41·3	38·6	36·2	34·0	
141B	15¼ × ″	*105*	*88·0*	*75·5*	66·0	58·7	52·8	48·0	44·0	40·6	37·7	35·2	33·0	31·1	
140B	15 × ″	*95·6*	79·7	68·3	59·7	53·1	47·8	43·5	39·8	36·8	34·1	31·9	29·9	28·1	
139B	14¾ × ″	85·7	71·3	61·1	53·5	47·5	42·8	38·9	35·7	32·9	30·6	28·5	26·7		

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 54.
Safe working stress = 7 5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

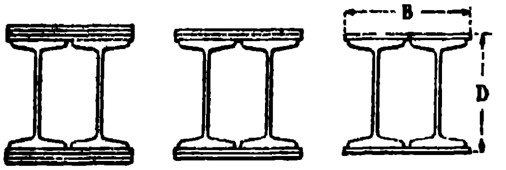
COMPOUND GIRDERS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Two Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
15 × 5	12 × 1½	209	60·7	2873	319·2	1596	113·5	·001041
"	" × 1¼	188½	54·7	2464	281·6	1408	94·5	·001071
"	" × 1	168	48·7	2078	244·5	1222	75·5	·001103
"	" × ⅞	158	45·7	1893	226·1	1130	66·0	·001119
"	" × ¾	147½	42·7	1714	207·8	1039	56·5	·001136
"	" × ⅝	137½	39·7	1540	189·6	948	47·0	·001151
"	" × ½	127½	36·7	1372	171·5	857	37·5	·001172
"	" × ⅜	117	33·7	1208	153·4	767	28·0	·001190
14 × 6*a*	14 × 2	307	89·5	4130	458·9	2294	143·0	·001041
"	" × 1¾	283	82·5	3643	416·3	2081	124·5	·001071
"	" × 1½	259½	75·5	3182	374·4	1872	106·0	·001103
"	" × 1¼	235½	68·5	2748	333·1	1665	88·0	·001136
"	" × 1	211½	61·5	2340	292·5	1462	70·5	·001172
"	" × ⅞	200	58·0	2145	272·4	1362	61·5	·001190
"	" × ¾	188	54·5	1956	252·4	1262	52·5	·001210
"	" × ⅝	176	51·0	1773	232·6	1163	44·0	·001230
"	" × ½	164	47·5	1596	212·9	1064	35·0	·001250
"	" × ⅜	152	44·0	1425	193·2	966	26·0	·001271
14 × 6*b*	14 × 1½	237½	69·0	3020	353·3	1766	106·0	·001103
"	" × 1¼	213½	62·0	2586	313·5	1567	88·0	·001136
"	" × 1	189½	55·0	2177	272·2	1361	70·0	·001172
"	" × ⅞	178½	51·5	1983	251·8	1259	61·5	·001190
"	" × ¾	166	48·0	1794	231·5	1157	52·5	·001210
"	" × ⅝	154	44·5	1611	211·3	1056	44·0	·001230
"	" × ½	142	41·0	1434	191·2	956	35·0	·001250
"	" × ⅜	130	37·5	1263	171·2	856	26·0	·001271

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.
Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.
For full explanations of tables, see notes commencing page 108.
For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

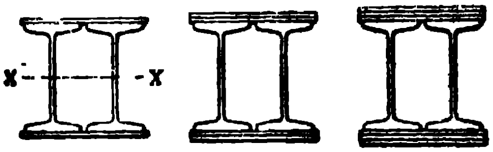
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET. 8	10	12	14	16	18	20	22	24	26	28	30	32	34
			Rivets ¾-in. diameter.												
132B	16 × 14												*64·7*	*60·7*	*57·1*
130B	15½ × "										*67·5*	*62·7*	*58·5*	*54·9*	*51·6*
128B	15 × "								*71·6*	*65·6*	*60·6*	*56·2*	*52·5*	*49·2*	*46·3*
126B	14½ × "						*77·8*	*70·1*	*63·7*	*58·4*	*53·9*	*50·0*	*46·7*	*43·8*	
124B	14 × "				*87·3*	*76·4*	*67·9*	*61·1*	*55·6*	*50·9*	47·0	43·7	40·7	38·2	
123B	13¾ × "			*94·7*	*81·2*	*71·0*	*63·1*	*56·8*	51·6	47·3	43·7	40·6	37·9		
122B	13½ × "		*105*	*87·6*	*75·1*	*65·7*	58·4	52·5	47·8	43·8	40·4	37·5	35·0		
121B	13¼ × "	*121*	*96·7*	*80·5*	69·0	60·4	53·7	48·3	43·9	40·3	37·2	34·5	32·2		
120B	13 × "	*110*	*88·2*	73·5	63·0	55·2	49·0	44·1	40·1	36·8	33·9	31·5	29·4		
119B	12¾ × "	100	79·9	66·6	57·1	50·0	44·4	40·0	36·3	33 3	30·8	28·6			
			Rivets ¾-in. diameter.												
108B	15 × 14								*68·4*	*62·7*	*57·9*	*53·7*	*50·1*	*47·0*	*44·2*
106B	14½ × "						*73·8*	*66·4*	*60·4*	*55·4*	*51·1*	*47·4*	*44·3*	*41·5*	
104B	14 × "				*81·9*	*71·7*	*63·7*	*57·4*	*52·1*	*47·8*	*44·1*	41·0	38·2	35·8	
103B	13¾ × "			*88·3*	*75·7*	*66·2*	*58·9*	*53·0*	*48·1*	44·1	40·8	37·8	35·3		
102B	13½ × "		*97·3*	*81·1*	*69·5*	*60·8*	*54·1*	48·6	44·2	40·5	37·4	34·8	32·4		
101B	13¼ × "		*88·7*	*73·9*	*63·4*	55·4	49·3	44·4	40·3	36·9	34·1	31·7	29·6		
100B	13 × "	*100*	*80·1*	66·8	57·3	50·1	44·5	40·1	36·4	33·4	30·8	28·6	26·7		
99B	12¾ × "	89·6	71·6	59·7	51·2	44·8	39·8	35·8	32·6	29·8	27·6	25·6			
			Rivets ¾-in. diameter.												
88B	15 × 12							*60·2*	*54·7*	*50·2*	*46·3*	*43·0*	*40·1*	*37·6*	*35·4*
86B	14½ × "					*65·9*	*58·6*	*52·7*	*47·9*	*43·9*	*40·6*	*37·7*	*35·1*	33·0	
84B	14 × "			*75·0*	*64·3*	*56·3*	*50·0*	*45·0*	*40·9*	*37·5*	34·6	32·2	30·0	28·1	
83B	13¾ × "			*68·8*	*59·0*	*51·6*	*45·9*	*41·3*	37·5	34·4	31·8	29·5	27·5		
82B	13½ × "	*94·0*	*75·2*	*62·7*	*53·7*	*47·0*	41·8	37·6	34·2	31·3	28·9	26·8	25·1		
81B	13¼ × "	*84·9*	*67·8*	*56·5*	48·5	42·4	37·7	34·0	30·8	28·3	26·1	24·2	22·6		
80B	13 × "	*75·8*	60·6	50·5	43·3	37·9	33·7	30·3	27·5	25·2	23·3	21·6	20·2		
79B	12¾ × "	66·7	53·3	44·4	38·1	33·3	29·6	26·7	24·2	22·2	20·5	19·0			

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 55.
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



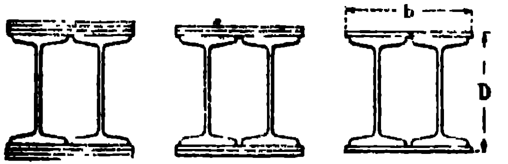
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Two Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
12 × 6*a*	14 × 2	301	87·7	3106	388·2	1941	123·0	·001172
"	" × 1¾	277	80·7	2722	351·2	1756	107·0	·001210
"	" × 1½	253½	73·7	2362	315·0	1575	91·5	·001250
"	" × 1¼	229½	66·7	2031	280·2	1401	76·0	·001293
"	" × 1	205½	59·7	1711	244·5	1222	60·5	·001339
"	" × ⅞	194	56·2	1562	227·3	1136	52·5	·001364
"	" × ¾	182	52·7	1419	210·2	1051	45·0	·001389
"	" × ⅝	170	49·2	1281	193·3	966	37·5	·001415
"	" × ½	158	45·7	1147	176·5	882	30·0	·001442
"	" × ⅜	146	42·2	1019	159·9	799	22·5	·001471
12 × 6*b*	14 × 1½	233½	67·8	2257	300·9	1504	91·5	·001250
"	" × 1¼	209½	60·8	1926	265·7	1328	76·0	·001293
"	" × 1	185½	53·8	1606	229·4	1147	60·5	·001339
"	" × ⅞	174	50·3	1457	211·9	1059	52·5	·001364
"	" × ¾	162	46·8	1314	194·6	973	45·0	·001389
"	" × ⅝	150	43·3	1175	177·4	887	37·5	·001415
"	" × ½	138	39·8	1042	160·3	801	30·0	·001442
"	" × ⅜	126	36·3	914	143·3	716	22·5	·001471
12 × 5	12 × 1½	189	54·8	1806	240·8	1204	91·5	·001250
"	" × 1¼	168½	48·8	1529	210·9	1054	76·0	·001293
"	" × 1	148	42·8	1260	180·1	900	60·5	·001339
"	" × ⅞	138	39·8	1136	165·2	826	52·5	·001364
"	" × ¾	127½	36·8	1015	150·4	752	45·0	·001389
"	" × ⅝	117½	33·8	899	135·7	678	37·5	·001415
"	" × ½	107½	30·8	787	121·2	606	30·0	·001442
"	" × ⅜	97	27·8	680	106·7	533	22·5	·001471

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

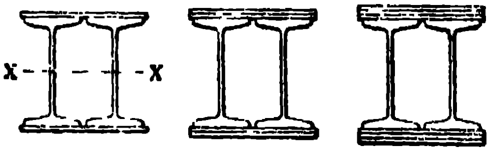
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.												
		6	8	10	12	14	16	18	20	22	24	26	28	30
68B	13 × 14									*56·2*	*51·5*	*47·5*	*44·1*	*41·2*
66B	12½ × "		Rivets ¾-in. diameter.					*60·2*	*54·2*	*49·3*	*45·2*	*41·7*	*38·7*	
64B	12 × "					*66·9*	*58·5*	*52·0*	*46·8*	*42·5*	*39·0*	*36·0*	33·4	
63B	11¾ × "				*71·9*	*61·7*	*53·9*	*48·0*	*43·2*	*39·2*	36·0	33·2		
62B	11½ × "			*79·1*	*65·9*	*56·5*	*49·5*	*44·9*	39·6	36·0	33·0	30·4		
61B	11¼ × "		*90·0*	*72·0*	*60·0*	*51·4*	45·0	40·0	36·0	32·7	30·0	27·7		
60B	11 × "		*81·2*	*64·9*	54·1	46·4	40·6	36·1	32·5	29·5	27·0	25·0		
59B	10¾ × "	*96·6*	72·4	57·9	48·3	41·4	36·2	32·2	29·0	26·3	24·1			
48B	13 × 12		Rivets ¾-in. diameter.						*49·5*	*45·0*	*41·2*	*38·1*	*35·3*	*33·0*
46B	12½ × "						*53·8*	*47·8*	*43·0*	*39·1*	*35·9*	*33·1*	*30·7*	
44B	12 × "				*61·2*	*52·5*	*45·9*	*40·8*	*36·7*	*33·4*	*30·6*	28·3	26·2	
43B	11¾ × "				*56·0*	*48·0*	*42·0*	*37·3*	*33·6*	30·5	28·0	25·9		
42B	11½ × "			*61·0*	*50·9*	*43·6*	*38·2*	33·9	30·5	27·7	25·4	23·5		
41B	11¼ × "		*68·7*	*55·0*	*45·8*	39·3	34·3	30·5	27·5	25·0	22·9	21·1		
40B	11 × "	*81·5*	*61·1*	*48·9*	40·8	34·9	30·6	27·2	24·5	22·2	20·4	18·8		
39B	10¾ × "	*71·5*	53·6	42·9	35·7	30·6	26·8	23·8	21·5	19·5	17·9			
28B	11 × 14									*43·0*	*39·4*	*36·4*		
26B	10½ × "							*47·6*	*41·0*	*37·3*	*34·2*			
24B	10 × "					*49·9*	*43·7*	*38·8*	*34·9*	*31·7*	*29·1*			
23B	9¾ × "				*53·2*	*45·6*	*39·9*	*35·5*	*31·9*	*29·0*			Rivets ⅞-in. diameter.	
22B	9½ × "			*58·0*	*48·4*	*41·5*	*36·3*	*32·2*	29·0	26·4				
21B	9¼ × "		*65·3*	*52·2*	*43·5*	*37·3*	32·6	29·0	26·1	23·7				
20B	9 × "	*77·6*	*58·2*	*46·5*	38·8	33·2	29·1	25·8	23·3	21·2				
19B	8¾ × "	*68·3*	*51·2*	40·9	34·1	29·3	25·6	22·7	20·4					
14B	10 × 12				*47·9*	*41·1*	*35·9*	*31·9*	*28·7*	*26·1*	24·0			
13B	9¾ × "			*52·5*	*43·7*	*37·5*	*32·8*	*29·2*	*26·2*	23·8				
12B	9½ × "			*47·5*	*39·6*	*34·0*	*29·7*	26·4	23·8	21·6			Rivets ¾-in diameter.	
11B	9¼ × "		*53·3*	*42·6*	*35·5*	30·5	26·7	23·7	21·3	19·4				
10B	9 × "	*63·1*	*47·3*	*37·8*	31·5	27·0	23·6	21·0	18·9	17·2				
9B	8¾ × "	*55·2*	41·4	33·1	27·6	23·6	20·7	18·4	16·5					

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch
Girders supporting tabular loads printed in italics require a closer pitch of rivets See page 55
Safe working stress = 7 5 tons per square inch, equal to a factor of safety of 4 Ends of girders simply supported

COMPOUND GIRDERS.

Composition and Properties.



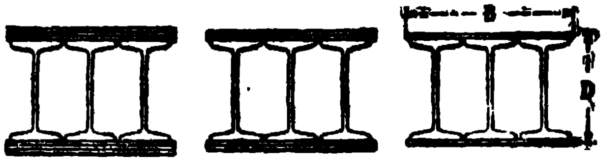
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Two Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
10 × 6	14 × 1½	229½	66·7	1607	**247·3**	1236	76·5	·001442
"	" × 1¼	205½	59·7	1356	**216·9**	1084	63·5	·001500
"	" × 1	181½	52·7	1124	**187·3**	936	50·5	·001563
"	" × ⅞	170	49·2	1015	**172·7**	863	44·0	·001596
"	" × ¾	158	45·7	910	**158·3**	791	37·5	·001630
"	" × ⅝	146	42·2	810	**144·0**	720	31·5	·001667
"	" × ½	134	38·7	714	**129·9**	649	25·0	·001704
"	" × ⅜	122	35·2	623	**115·9**	579	18·5	·001744
10 × 5	12 × 1½	185	53·6	1286	**197·9**	989	76·5	·001442
"	" × 1¼	164½	47·6	1076	**172·1**	860	63·5	·001500
"	" × 1	144	41·6	881	**146·8**	734	50·5	·001563
"	" × ⅞	134	38·6	790	**134·4**	672	44·0	·001596
"	" × ¾	123½	35·6	702	**122·1**	610	37·5	·001630
"	" × ⅝	113½	32·6	618	**109·9**	549	31·5	·001667
"	" × ½	103½	29·6	538	**97·8**	489	25·0	·001704
"	" × ⅜	93	26·6	461	**85·8**	429	18·5	·001744
8 × 6	14 × 1½	215½	62·5	1040	**189·1**	945	62·0	·001704
"	" × 1¼	191½	55·5	861	**164·0**	820	51·0	·001785
"	" × 1	167½	48·5	698	**139·7**	698	40·5	·001875
"	" × ⅞	156	45·0	623	**127·8**	639	35·5	·001923
"	" × ¾	144	41·5	551	**116·1**	580	30·0	·001974
"	" × ⅝	132	38·0	483	**104·5**	522	25·0	·002027
"	" × ½	120	34·5	419	**93·1**	465	20·0	·002083
"	" × ⅜	108	31·0	358	**81·8**	409	15·0	·002143
8 × 5	12 × 1	140	40·4	575	**115·0**	575	40·5	·001875
"	" × ⅞	130	37·4	512	**105·0**	525	35·5	·001923
"	" × ¾	119½	34·4	452	**95·1**	475	30·0	·001974
"	" × ⅝	109½	31·4	395	**85·3**	426	25·0	·002027
"	" × ½	99½	28·4	341	**75·7**	378	20·0	·002083
"	" × ⅜	89	25·4	289	**66·2**	331	15·0	·002143

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

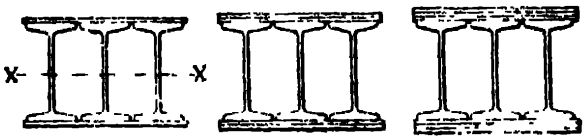
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		14	16	18	20	22	24	26	28	30	32	34	36	40	44
296C	29 × 24									*297*	*278*	*262*	*248*	*228*	*203*
294C	28½ × "	Rivets ⅞-in. diameter.							*296*	*277*	*259*	*244*	*230*	*207*	*189*
292C	28 × "						*321*	*296*	*275*	*257*	*240*	*226*	*214*	*192*	*175*
290C	27½ × "				*354*	*322*	*295*	*273*	*253*	*236*	*221*	*208*	*197*	177	161
288C	27 × "			*361*	*325*	*295*	*270*	*250*	*232*	*216*	*203*	191	180	162	147
286C	26½ × "		*369*	*328*	*295*	*268*	*246*	*227*	211	197	185	173	164	147	134
284C	26 × "	*379*	*332*	*295*	266	241	221	204	190	177	166	156	147	133	121
283C	25¾ × "	*359*	*314*	279	251	228	209	193	179	167	157	148	139	125	114
282C	25½ × "	338	295	263	236	215	197	182	169	158	148	139	131	118	107
281C	25¼ × "	317	277	246	222	202	185	171	158	148	139	130	123	111	101
280C	25 × "	296	259	230	207	188	173	159	148	138	130	122	115	104	94·0
276C	25 × 24	Rivets ¾-in. diameter.								*240*	*225*	*212*	*200*	*180*	*163*
274C	24½ × "								*238*	*223*	*209*	*196*	*185*	*167*	*152*
272C	24 × "						*257*	*237*	*220*	*206*	*193*	*181*	*171*	*154*	*140*
270C	23½ × "				*283*	*257*	*236*	*218*	*202*	*189*	*177*	*167*	*157*	*142*	129
268C	23 × "			*287*	*258*	*235*	*215*	*199*	*184*	*172*	*161*	152	143	129	117
266C	22½ × "	*333*	*292*	*259*	*233*	*212*	*194*	*180*	167	156	146	137	130	117	106
264C	22 × "	*298*	*261*	*232*	209	190	174	161	149	139	131	123	116	104	94·9
263C	21¾ × "	*281*	*246*	218	197	179	164	151	141	131	123	116	109	98·3	89·4
262C	21½ × "	264	231	205	184	168	154	142	132	123	115	108	102	92·3	83·9
261C	21¼ × "	246	216	192	172	157	144	133	123	115	108	101	95·8	86·3	78·4
260C	21 × "	229	201	178	160	146	134	123	115	107	100	94·4	89·2	80·2	73·0

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 56
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4 Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



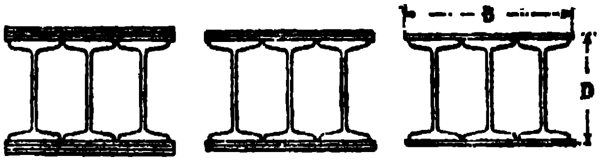
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Three Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
24 × 7½	24 × 2½	713½	208·1	25848	1782·7	8913	303·5	·000646
"	" × 2¼	672½	196·1	23658	1660·2	8301	272·5	·000658
"	" × 2	632	184·1	21545	1538·9	7694	242·0	·000669
"	" × 1¾	591	172·1	19505	1418·5	7092	211·0	·000681
"	" × 1½	550	160·1	17539	1299·0	6495	180·5	·000694
"	" × 1¼	509½	148·1	15643	1180·7	5903	150·5	·000707
"	" × 1	468½	136·1	13818	1062·9	5314	120·0	·000721
"	" × ⅞	448	130·1	12932	1004·5	5022	105·0	·000728
"	" × ¾	428	124·1	12062	946·1	4730	90·0	·000735
"	" × ⅝	407½	118·1	11210	887·9	4439	75·0	·000742
"	" × ½	387	112·1	10374	829·9	4149	60·0	·000750
20 × 7½	24 × 2½	680½	198·4	17979	1438·3	7191	254·0	000750
"	" × 2¼	639½	186·4	16356	1335·2	6676	228·0	·000765
"	" × 2	599	174·4	14799	1233·2	6166	202·0	·000781
"	" × 1¾	558	162·4	13305	1132·3	5661	176·5	·000797
"	" × 1½	517½	150·4	11873	1032·4	5162	151·0	·000815
"	" × 1¼	476½	138·4	10502	933·5	4667	125·5	·000833
"	" × 1	435½	126·4	9191	835·6	4178	100·0	·000852
"	" × ⅞	415½	120·4	8557	786·9	3934	87·5	·000862
"	" × ¾	395	114·4	7938	738·4	3692	75·0	·000872
"	" × ⅝	374½	108·4	7333	690·2	3451	62·5	·000880
"	" × ½	354	102·4	6742	642·1	3210	50·0	·000893

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

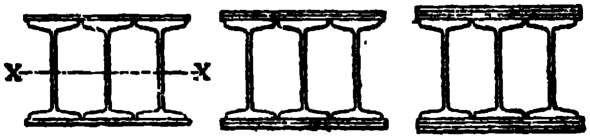
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET. 14	16	18	20	22	24	26	28	30	32	34	36	40	44
256C	23 × 24										*194*	*182*	*172*	*155*	*141*
254C	22½ × "	Rivets ⅞-in.							*205*	*191*	*179*	*168*	*159*	*143*	*130*
252C	22 × "	diameter.					*219*	*202*	*188*	*175*	*164*	*155*	*146*	*131*	*119*
250C	21½ × "					*218*	*200*	*185*	*171*	*160*	*150*	*141*	*133*	*120*	109
248C	21 × "			*241*	*217*	*197*	*181*	*167*	*155*	*145*	*136*	*128*	121	109	98·8
246C	20½ × "	*278*	*243*	*216*	*195*	*177*	*162*	*150*	139	130	122	114	108	97·4	88·6
244C	20 × "	*246*	*216*	*192*	*173*	157	144	133	123	115	108	101	95·8	86·2	78·4
243C	19¾ × "	*231*	*202*	179	161	147	134	124	115	108	101	95·0	89·7	80·7	73·4
242C	19½ × "	*215*	188	167	150	137	125	116	107	100	94·0	88·5	83·6	75·2	68·4
241C	19¼ × "	199	174	155	139	127	116	107	99·7	93·0	87·2	82·1	77·5	69·8	63·4
240C	19 × "	184	161	143	129	117	107	98·9	91·9	85·7	80·4	75·7	71·4	64·3	58·5
232C	20 × 21	Rivets ¾-in.								*133*	*125*	*117*	*111*	*99·8*	*90·7*
230C	19½ × "	diameter.						*140*	*130*	*121*	*113*	*107*	*101*	*90·7*	*82·5*
228C	19 × "					*149*	*136*	*126*	*117*	*109*	*102*	*96·3*	*90·9*	*81·8*	74·4
226C	18½ × "			*162*	*140*	*133*	*122*	*112*	*104*	*97·3*	*91·3*	85·9	81·1	73·0	66·4
224C	18 × "	*184*	*161*	*143*	*128*	*117*	*107*	98·9	91·8	85·7	80·4	75·6	71·4	64·3	58·5
223C	17¾ × "	*171*	*150*	*133*	*120*	109	100	92·3	85·7	79·9	75·0	70·5	66·6	60·0	
222C	17½ × "	*159*	*139*	124	111	101	92·8	85·7	79·5	74·2	69·6	65·5	61·9	55·7	
221C	17¼ × "	147	128	114	103	93·4	85·7	79·1	73·4	68·5	64·3	60·5	57·1	51·4	
220C	17 × "	135	118	105	94·3	85·7	78·6	72·6	67·4	62·9	59·0	55·5	52·4	47·2	
212C	19 × 21	Rivets ¾-in.								*124*	*116*	*109*	*103*	*93·0*	*84·5*
210C	18½ × "	diameter.						*130*	*121*	*112*	*105*	*99·3*	*93·8*	*84·4*	*76·8*
208C	18 × "					*138*	*127*	*117*	*109*	*101*	*95·1*	*89·5*	*84·5*	*76·1*	69·2
206C	17½ × "			*151*	*136*	*123*	*113*	*104*	*96·8*	*90·4*	*84·7*	79·7	75·3	67·8	
204C	17 × "	*170*	*149*	*132*	*119*	*108*	*99·4*	91·8	85·2	79·5	74·6	70·2	66·3	59·7	
203C	16¾ × "	*159*	*139*	*123*	*111*	101	92·6	85·5	79·4	74·1	69·5	65·4	61·8		
202C	16½ × "	*147*	*129*	115	103	93·7	86·0	79·4	73·7	68·8	64·5	60·7	57·3		
201C	16¼ × "	136	119	106	95·2	86·5	79·3	73·2	68·0	63·5	59·5	56·0	52·9		
200C	16 × "	125	109	96·9	87·3	79·3	72·7	67·1	62·3	58·1	54·5	51·3	48·5		

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 57.
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



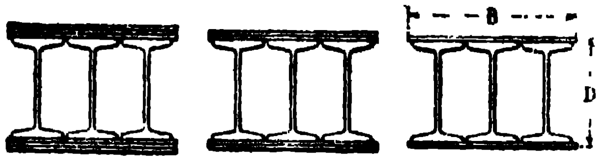
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Three Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
18 × 7	24 × 2½	638½	186·1	14259	1239·9	6199	229·5	·000815
"	" × 2¼	598	174·1	12888	1145·7	5728	206·0	·000833
"	" × 2	557	162·1	11577	1052·5	5262	182·5	·000852
"	" × 1¾	516½	150·1	10324	960·4	4802	159·0	·000872
"	" × 1½	475½	138·1	9128	869·4	4347	136·0	·000893
"	" × 1¼	434½	126·1	7988	779·3	3896	113·0	·000914
"	" × 1	394	114·1	6902	690·2	3451	90·0	·000937
"	" × ⅞	373½	108·1	6379	645·9	3229	79·0	·000949
"	" × ¾	353	102·1	5869	601·9	3009	67·5	·000961
"	" × ⅝	332½	96·1	5371	558·1	2790	56·0	·000974
"	" × ½	312½	90·1	4887	514·5	2572	45·0	·000987
16 × 6	21 × 2	475	138·6	7983	798·3	3991	162·5	·000937
"	" × 1¾	439½	128·1	7078	726·0	3630	141·5	·000961
"	" × 1½	403½	117·6	6218	654·6	3273	121·0	·000987
"	" × 1¼	368	107·1	5402	584·1	2920	100·5	·001013
"	" × 1	332½	96·6	4630	514·4	2572	80·5	·001041
"	" × ⅞	314½	91·4	4259	479·9	2399	70·0	·001056
"	" × ¾	296½	86·1	3899	445·6	2228	60·0	·001071
"	" × ⅝	279	80·9	3548	411·4	2057	50·0	·001087
"	" × ½	261	75·6	3208	377·4	1887	40·0	·001103
15 × 6	21 × 2	466	136·0	7066	743·8	3719	152·5	·000987
"	" × 1¾	430½	125·5	6250	675·6	3378	133·0	·001013
"	" × 1½	395	115·0	5477	608·7	3043	113·5	·001041
"	" × 1¼	359	104·5	4746	542·4	2712	94·5	·001071
"	" × 1	323½	94·0	4056	477·2	2386	75·5	·001103
"	" × ⅞	305½	88·7	3725	444·8	2224	66·0	·001119
"	" × ¾	287½	83·5	3405	412·7	2063	56·5	·001136
"	" × ⅝	270	78·2	3094	380·8	1904	47·0	·001151
"	" × ½	252	73·0	2792	349·0	1745	37·5	·001172

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

For full explanations of tables see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

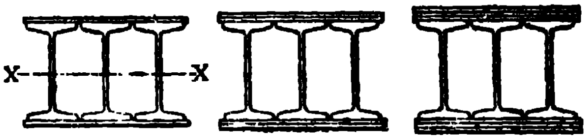
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		10	12	14	16	18	20	22	24	26	28	30	32	34	36
188C	18 × 18	Rivets ¾-in. diameter.					*120*	*109*	*99·8*	*92·1*	*85·5*	*79·8*	*74·8*	*70·4*	*66·5*
186C	17½ × "				*132*	*117*	*105*	*96·0*	*88·0*	*81·2*	*75·4*	*70·4*	66·0	62·1	58·6
184C	17 × "		*153*	*131*	*114*	*102*	*91·7*	*83·3*	76·4	70·5	65·4	61·1	57·3	53·9	50·9
183C	16¾ × "	*170*	*141*	*121*	*106*	*94·2*	84·8	77·0	70·6	65·2	60·5	56·5	53·0	49·9	47·1
182C	16½ × "	*156*	*130*	*111*	*97·4*	86·6	77·9	70·8	64·9	59·9	55·7	51·9	48·7	45·8	43·3
181C	16¼ × "	*142*	*118*	101	88·9	79·0	71·1	64·6	59·2	54·7	50·8	47·4	44·4	41·8	39·5
180C	16 × "	129	107	91·8	80·4	71·4	64·3	58·4	53·6	49·4	45·9	42·8	40·2	37·8	35·7
179C	15¾ × "	115	95·9	82·2	71·9	63·9	57·5	52·3	48·0	44·3	41·1	38·4	36·0	33·8	
172C	18 × 20										*118*	*110*	*103*	*97·0*	*91·6*
170C	17½ × "	Rivets ¾-in. diameter.							*125*	*115*	*107*	*99·9*	*93·7*	*88·2*	*83·3*
168C	17 × "						*135*	*123*	*112*	*104*	*96·5*	*90·0*	*84·5*	*79·5*	*75·0*
166C	16½ × "				*151*	*134*	*120*	*109*	*100*	*92·7*	*86·1*	*80·3*	75·3	70·9	66·9
164C	16 × "			*152*	*133*	*118*	*106*	*96·5*	*88·5*	81·7	75·8	70·8	66·4	62·4	59·0
163C	15¾ × "	*198*	*165*	*141*	*124*	*110*	99·1	90·0	82·6	76·2	70·8	66·0	61·9	58·3	
162C	15½ × "	*184*	*153*	*131*	*115*	102	92·0	83·6	76·7	70·8	65·7	61·3	57·5	54·1	
161C	15¼ × "	*170*	*142*	121	106	94·5	85·0	77·2	70·8	65·4	60·7	56·7	53·1	50·0	
160C	15 × "	156	130	111	97·6	86·7	78·1	70·9	65·1	60·1	55·8	52·0	48·8	45·9	
159C	14¾ × "	142	118	102	88·9	79·0	71·1	64·6	59·3	54·7	50·8	47·4	44·4		
148C	17 × 20	Rivets ¾-in. diameter.						*116*	*106*	*98·4*	*91·4*	*85·3*	*80·0*	*75·2*	*71·1*
146C	16½ × "					*126*	*113*	*103*	*94·2*	*87·0*	*80·8*	*75·4*	*70·7*	66·5	62·8
144C	16 × "			*141*	*123*	*109*	*98·5*	*89·5*	*82·1*	*75·8*	70·4	65·7	61·6	57·9	54·7
143C	15¾ × "		*152*	*130*	*114*	*101*	*91·4*	83·0	76·1	70·2	65·2	60·9	57·1	53·7	
142C	15½ × "	*168*	*140*	*120*	*105*	93·5	84·1	76·4	70·1	64·7	60·1	56·1	52·6	49·5	
141C	15¼ × "	*154*	*128*	110	96·3	85·6	77·0	70·0	64·2	59·3	55·0	51·3	48·1	45·3	
140C	15 × "	*140*	116	99·9	87·4	77·7	69·9	63·6	58·3	53·8	49·9	46·6	43·7	41·1	
139C	14¾ × "	126	105	89·9	78·6	69·9	62·9	57·1	52·4	48·4	44·9	41·9	39·3		

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 57
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



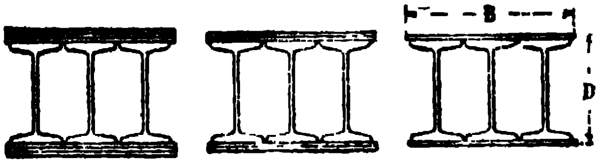
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Three Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
15 × 5	18 × 1½	313	91·0	4309	478·8	2394	113·5	·001041
"	" × 1¼	282½	82·0	3696	422·4	2112	94·5	·001071
"	" × 1	252	73·0	3117	366·7	1833	75·5	·001103
"	" × ⅞	236½	68·5	2840	339·1	1695	66·0	·001119
"	" × ¾	221½	64·0	2571	311·7	1558	56·5	·001136
"	" × ⅝	206	59·5	2311	284·4	1422	47·0	·001151
"	" × ½	191	55·0	2058	257·2	1286	37·5	·001172
"	" × ⅜	175½	50·5	1813	230·2	1151	28·0	·001190
14 × 6*a*	20 × 2	446½	130·3	5938	659·8	3299	143·0	·001041
"	" × 1¾	412½	120·3	5246	599·6	2998	124·5	·001071
"	" × 1½	378½	110·3	4593	540·3	2701	106·0	·001103
"	" × 1¼	344½	100·3	3977	482·1	2410	88·0	·001136
"	" × 1	310½	90·3	3397	424·7	2123	70·5	·001172
"	" × ⅞	293½	85·3	3121	396·3	1981	61·5	·001190
"	" × ¾	276½	80·3	2853	368·1	1840	52·5	·001210
"	" × ⅝	259½	75·3	2593	340·1	1700	44·0	·001230
"	" × ½	242½	70·3	2342	312·3	1561	35·0	·001250
"	" × ⅜	225½	65·3	2099	284·6	1423	26·0	·001271
14 × 6*b*	20 × 1½	345½	100·5	4349	511·7	2558	106·0	·001103
"	" × 1¼	311½	90·5	3733	452·5	2262	88·0	·001136
"	" × 1	277½	80·5	3154	394·2	1971	70·5	·001172
"	" × ⅞	260½	75·5	2877	365·3	1826	61·5	·001190
"	" × ¾	243½	70·5	2609	336·6	1683	52·5	·001210
"	" × ⅝	226½	65·5	2349	308·1	1540	44·0	·001230
"	" × ½	209½	60·5	2098	279·8	1399	35·0	·001250
"	" × ⅜	192½	55·5	1856	251·6	1258	26·0	·001271

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^4$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

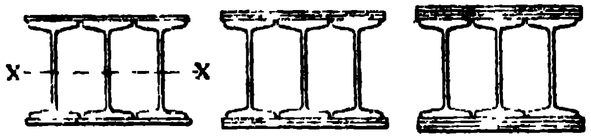
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	8	10	12	14	16	18	20	22	24	26	28	30	32	34
		SPANS IN FEET.													
132C	16 × 20											*99·6*	*92·9*	*87·1*	*82·0*
130C	15½ × "		Rivets ¾-in.							*105*	*97·2*	*90·2*	*84·2*	*79·0*	*74·3*
128C	15 × "		diameter.					*113*	*103*	*94·6*	*87·3*	*81·1*	*75·7*	*70·9*	*66·8*
126C	14½ × "					*127*	*112*	*101*	*92·0*	*84·4*	*77·9*	*72·3*	*67·5*	63·3	
124C	14 × "			*148*	*127*	*111*	*98·5*	*88·7*	*80·6*	73·9	68·2	63·3	59·1	55·4	
123C	13¾ × "		*165*	*138*	*118*	*103*	*91·8*	82·6	75·1	68·8	63·5	59·0	55·1		
122C	13½ × "		*153*	*128*	*109*	*95·7*	85·1	76·6	69·6	63·8	58·9	54·7	51·0		
121C	13¼ × "	*176*	*141*	*118*	101	88·2	78·4	70·6	64·2	58·8	54·3	50·4	47·1		
120C	13 × "	*162*	129	108	92·4	80·9	71·8	64·7	58·8	53·9	49·8	46·2	43·1		
119C	12¾ × "	147	118	98·0	84·0	73·5	65·4	58·8	53·4	49·0	45·2	42·0			
108C	15 × 20		Rivets ¾-in.						*98·4*	*90·2*	*83·3*	*77·3*	*72·2*	*67·7*	*63·7*
106C	14½ × "		diameter.				*107*	*95·8*	*87·1*	*79·9*	*73·7*	*68·4*	*63·9*	*59·9*	
104C	14 × "				*118*	*104*	*92·3*	*83·0*	*75·4*	*69·2*	63·9	59·3	55·3	51·9	
103C	13¾ × "			*128*	*110*	*96·1*	*85·4*	*76·9*	69·8	64·0	59·1	54·9	51·2		
102C	13½ × "		*141*	*118*	*101*	*88·4*	78·6	70·7	64·2	58·9	54·4	50·5	47·1		
101C	13¼ × "	*162*	*129*	*108*	92·3	80·8	71·8	64·6	58·7	53·9	49·7	46·2	43·1		
100C	13 × "	*147*	*117*	97·7	83·7	73·2	65·1	58·6	53·2	48·8	45·1	41·8	39·0		
99C	12¾ × "	132	105	87·7	75·2	65·8	58·4	52·6	47·8	43·9	40·5	37·6			
88C	15 × 18		Rivets ¾-in.					*90·3*	*82·0*	*75·2*	*69·4*	*64·5*	*60·2*	*56·4*	*53·1*
86C	14½ × "		diameter			*98·8*	*87·8*	*79·1*	*71·8*	*65·9*	*60·8*	*56·5*	*52·7*	49·4	
84C	14 × "			*113*	*96·5*	*84·4*	*75·0*	*67·5*	*61·3*	*56·3*	51·9	48·2	45·0	42·2	
83C	13¾ × "			*103*	*88·5*	*77·4*	*68·8*	*61·9*	56·3	51·6	47·7	44·2	41·3		
82C	13½ × "		*113*	*94·0*	*80·5*	*70·5*	62·7	56·4	51·2	47·0	43·4	40·3	37·6		
81C	13¼ × "	*127*	*102*	*84·8*	72·7	63·6	56·6	50·9	46·3	42·4	39·1	36·4	33·9		
80C	13 × "	*114*	*90·9*	75·7	64·9	56·8	50·5	45·4	41·3	37·8	34·9	32·4	30·3		
79C	12¾ × "	100	80·0	66·7	57·1	50·0	44·4	40·0	36·3	33·3	30·8	28·6			

Tabular loads to right of full zigzag line produce deflection greater than 1/26 of an inch per foot of span.
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.
Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 58.
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4 Ends of girders simply supported

COMPOUND GIRDERS.

Composition and Properties.



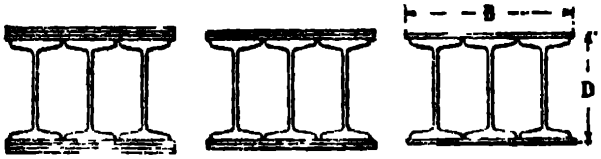
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Three Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
12 × 6*a*	20 × 2	437½	127·6	446	**557·6**	2788	123·0	·001172
"	" × 1¾	403½	117·6	391	**505·4**	2527	107·0	·001210
"	" × 1½	369½	107·6	3406	**454·1**	2270	91·5	·001250
"	" × 1¼	335½	97·6	2937	**405·1**	2025	76·0	·001293
"	" × 1	301½	87·6	2483	**354·7**	1773	60·5	·001339
"	" × ⅞	284½	82·6	2271	**330·4**	1652	52·5	·001364
"	" × ¾	267½	77·6	2067	**306·3**	1531	45·0	·001389
"	" × ⅝	250½	72·6	1871	**282·4**	1412	37·5	·001415
"	" × ½	233½	67·6	1682	**258·8**	1294	30·0	·001442
"	" × ⅜	216½	62·6	1500	**235·3**	1176	22·5	·001471
12 × 6*b*	20 × 1½	339½	98·8	3248	**433·1**	2165	91·5	·001250
"	" × 1¼	305½	88·8	2779	**383·3**	1916	76·0	001293
"	" × 1	271½	78·8	2324	**332·1**	1660	60·5	·001339
"	" × ⅞	254½	73·8	2113	**307·4**	1537	52·5	·001364
"	" × ¾	237½	68·8	1909	**282·8**	1414	45·0	·001389
"	" × ⅝	220½	63·8	1713	**258·6**	1293	37·5	·001415
"	" × ½	203½	58 8	1524	**234·4**	1172	30·0	·001442
"	" × ⅜	186½	53·8	1342	**210·5**	1052	22·5	·001471
12 × 5	18 × 1½	283	82·2	2709	**361·2**	1806	91·5	·001250
"	" × 1¼	252½	73·2	2293	**316·3**	1581	76·0	·001293
"	" × 1	222	64·2	1891	**270·1**	1350	60·5	·001339
"	" × ⅞	206½	59·7	1703	**247·8**	1239	52·5	·001364
"	" × ¾	191½	55·2	1523	**225·6**	1128	45·0	·001389
"	" × ⅝	176	50·7	1349	**203·6**	1018	37·5	·001415
"	" × ½	161	46·2	1181	**181·7**	908	30·0	·001442
"	" × ⅜	145½	41·7	1020	**160·0**	800	22·5	·001471

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

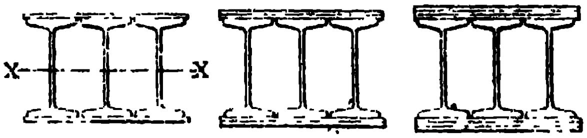
Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.												
		6	8	10	12	14	16	18	20	22	24	26	28	30
68C	13 × 20								*88·9*	*80·8*	*74·1*	*68·4*	*63·5*	*59·3*
66C	12½ × ”		Rivets ⅞-in. diameter.					*86·9*	*78·2*	*71·1*	*65·1*	*60·1*	*55·8*	
64C	12 × ”					*96·7*	*84·6*	*75·2*	*67·7*	*61·5*	*56·4*	52·1	48·3	
63C	11¾ × ”				*104*	*89·4*	*78·2*	*69·5*	*62·6*	56·8	52·1	48·1		
62C	11½ × ”			*115*	*95·8*	*83·1*	*71·8*	63·8	57·5	52·2	47·9	44·2		
61C	11¼ × ”		*131*	*105*	*87·4*	74·9	65·5	58·2	52·4	47·6	43·7	40·3		
60C	11 × ”		*119*	*94·9*	79·1	67·8	59·3	52·7	47·4	43·1	39·5	36·5		
59C	10¾ × ”	*142*	106	85·0	70·9	60·8	53·1	47·2	42·5	38·6	35·5			
48C	13 × 18		Rivets ⅞-in. diameter.						*74·2*	*67·5*	*61·9*	*57·1*	*53·0*	*49·5*
46C	12½ × ”						*80·7*	*71·7*	*64·5*	*58·6*	*53·8*	*49·6*	*46·1*	
44C	12 × ”				*91·8*	*78·7*	*68·8*	*61·2*	*55·1*	*50·0*	45·9	42·4	39·3	
43C	11¾ × ”				*84·0*	*72·0*	*63·0*	*56·0*	*50·4*	45·8	42·0	38·8		
42C	11½ × ”			*91·5*	*76·3*	*65·4*	*57·2*	50·8	45·8	41·6	38·1	35·2		
41C	11¼ × ”		*103*	*82·4*	*68·7*	58·8	51·5	45·8	41·2	37·4	34·3	31·7		
40C	11 × ”	*122*	*91·7*	*73·3*	61·1	52·4	45·9	40·8	36·7	33·3	30·6	28·2		
39C	10¾ × ”	*107*	80·4	64·3	53·6	46·0	40·2	35·7	32·2	29·3	26·8			
28C	11 × 20									*61·6*	*56·5*	*52·1*		
25C	10½ × ”							*65·5*	*58·9*	*53·5*	*49·1*			
24C	10 × ”					*71·9*	*62·9*	*55·9*	*50·3*	*45·7*	*42·0*			
23C	9¾ × ”				*76·9*	*65·9*	*57·7*	*51·3*	*46·1*	*41·9*				
22C	9½ × ”			*84·0*	*70·9*	*60·0*	*52·5*	*46·7*	42·0	38·2				
21C	9¼ × ”		*94·9*	*75·8*	*63·3*	*54·2*	47·4	42·1	37·9	34·4			Rivets ¾-in. diameter.	
20C	9 × ”	*113*	*84·8*	*67·8*	56·5	48·4	42·4	37·7	33·9	30·8				
19C	8¾ × ”	*99·9*	74·9	59·9	49·9	42·8	37·4	33·3	29·9					
14C	10 × 18				*71·9*	*61·6*	*53·9*	*47·9*	*43·1*	*39·2*	35·9			
13C	9¾ × ”				*65·6*	*56·2*	*49·2*	*43·7*	*39·4*	35·8				
12C	9½ × ”			*71·3*	*59·4*	*50·9*	*44·5*	39·6	35·6	32·4				
11C	9¼ × ”		*80·0*	*64·0*	*53·3*	45·7	40·0	35·5	32·0	29·1				
10C	9 × ”	*94·7*	*70·9*	*56·7*	47·3	40·6	35·5	31·5	28·4	25·8			Rivets ⅝-in. diameter.	
9C	8¾ × ”	*82·8*	62·1	49·6	41·4	35·5	31·0	27·6	24·8					

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span
Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch
Girders supporting tabular loads printed in italics require a closer pitch of rivets See page 58
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4 Ends of girders simply supported

COMPOUND GIRDERS.

Composition and Properties.



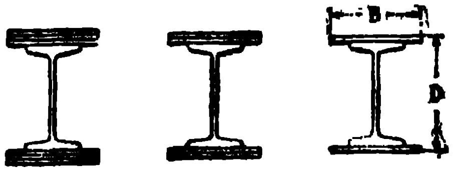
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Three Steel Joists.	Plates, each Flange to form.					Girder.	1 in. Plate Width.	
10 × 6	20 × 1½	333½	97·0	2311	355·6	1778	76·5	·001442
"	" × 1¼	299½	87·0	1954	312·7	1563	63·5	·001500
"	" × 1	265½	77·0	1625	270·8	1354	50·5	·001563
"	" × ⅞	248½	72·0	1470	250·3	1251	44·0	·001596
"	" × ¾	231½	67·0	1322	229·9	1149	37·5	·001630
"	" × ⅝	214½	62·0	1180	209·7	1048	31·5	·001667
"	" × ½	197½	57·0	1044	189·8	949	25·0	·001704
"	" × ⅜	180½	52·0	914	170·1	850	18·5	·001744
10 × 5	18 × 1½	277	80·4	1930	296·9	1484	76·5	·001442
"	" × 1¼	246½	71·4	1614	258·2	1291	63·5	·001500
"	" × 1	216	62·4	1322	220·3	1101	50·5	·001563
"	" × ⅞	200½	57·9	1184	201·6	1008	44·0	·001596
"	" × ¾	185½	53·4	1053	183·1	915	37·5	·001630
"	" × ⅝	170	48·9	927	164·8	824	31·5	·001667
"	" × ½	155	44·4	807	146·7	733	25·0	·001704
"	" × ⅜	139½	39·9	692	128·7	643	18·5	·001744
8 × 6	20 × 1½	312½	90·8	1491	271·1	1355	62·0	·001704
"	" × 1¼	278½	80·8	1238	235·7	1178	51·0	·001785
"	" × 1	244½	70·8	1007	201·4	1007	40·5	·001875
"	" × ⅞	227½	65·8	900	184·6	923	35·5	·001923
"	" × ¾	210½	60·8	798	168·0	840	30·0	·001974
"	" × ⅝	193½	55·8	702	151·7	758	25·0	·002027
"	" × ½	176½	50·8	610	135·6	678	20·0	·002083
"	" × ⅜	159½	45·8	524	119·8	599	15·0	·002143
8 × 5	18 × 1	210	60·7	862	172·5	862	40·5	·001875
"	" × ⅞	195	56·2	767	157·5	787	35·5	·001923
"	" × ¾	179½	51·7	677	142·6	713	30·0	·001974
"	" × ⅝	164	47·2	592	128·0	640	25·0	·002027
"	" × ½	149	42·7	511	113·5	577	20·0	·002083
"	" × ⅜	133½	38·2	434	99·3	496	15·0	·002143

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

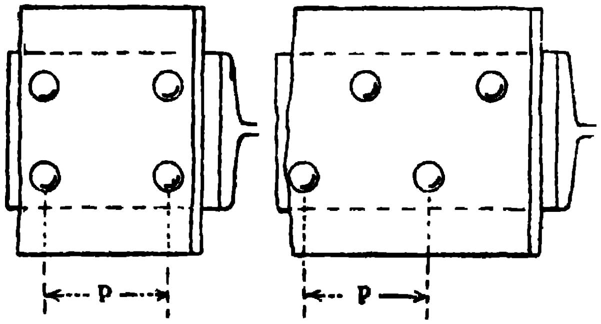
For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.



Straight Pitch.

Staggered or Reeled Pitch.

P = 3", 4", or 6".

The tables on this and the two following pages give the nearest pitch of rivets in *even* inches which should be adopted if the girders, pages 20 to 29, are used to support the full safe distributed tabular loads in italics.

Example:—Required rivet pitch for girder 274A, page 20, to support tabular load of 98 tons on a span of 32 feet.

Answer:—See girder 274A in this table, which gives 4 in. as the required pitch, the minimum span being 29·1 feet.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of		
		3-in.	4-in.	6-in.
296A	29 × 12	24·4	32·6	48·8
294A	28½ × "	21·8	29·1	43·6
292A	28 × "	19·2	25·6	38·4
290A	27½ × "	16·6	22·1	33·1
288A	27 × "	13·9	18·5	27·8
286A	26½ × "	11·2	14·9	22·4
284A	26 × "	8·6	11·4	17·1
283A	25¾ × "	7·3	9·7	14·5
282A	25½ × "	6·0	7·9	11·9
281A	25¼ × "	4·7	6·3	9·4
280A	25 × "	3·6	4·6	6·9

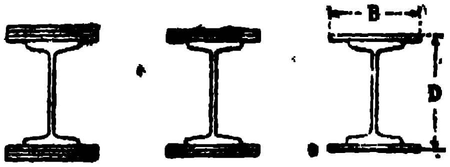
Rivets ⅞-in. diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
276A	25 × 12	24·4	32·6	48·8
274A	24½ × "	21·8	29·1	43·6
272A	24 × "	19·3	25·7	38·5
270A	23½ × "	16·4	21·9	32·8
268A	23 × "	14·0	18·7	28·0
266A	22½ × "	11·4	15·2	22·7
264A	22 × "	8·7	11·6	17·4
263A	21¾ × "	7·4	9·9	14·8
262A	21½ × "	6·1	8·1	12·2
261A	21¼ × "	4·8	6·4	9·6
260A	21 × "	3·6	4·8	7·1

Rivets ⅞-in. diam.

For safe loads and properties of these girders, see pages 20 and 21.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
256A	23 × 12	24·7	32·9	49·3
254A	22½ × "	22·1	29·5	44·2
252A	22 × "	19·8	26·4	39·6
250A	21½ × "	17·0	22·6	33·9
248A	21 × "	14·3	19·1	28·6
246A	20½ × "	11·7	15·6	23·4
244A	20 × "	9·0	12·0	18·0
243A	19¾ × "	7·7	10·3	15·4
242A	19½ × "	6·4	8·5	12·7
241A	19¼ × "	5·1	6·7	10·1
240A	19 × "	3·8	5·0	7·5

Rivets ⅞-in. diam

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
232A	20 × 10	22·1	29·4	44·2
230A	19½ × "	19·2	25·6	38·3
228A	19 × "	16·2	21·6	32·4
226A	18½ × "	13·3	17·7	26·5
224A	18 × "	10·3	13·7	20·5
223A	17¾ × "	8·8	11 7	17·5
222A	17½ × "	7·3	9·7	14·5
221A	17¼ × "	5·8	7·8	11·6
220A	17 × "	4·3	5·8	8·6

Rivets ¾-in. diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
212A	19 × 10	22·0	29·3	44·0
210A	18½ × "	19·1	25·5	38·3
208A	18 × "	16·2	21·6	32·4
206A	17½ × "	13·2	17·6	26·4
204A	17 × "	10·2	13·6	20·4
203A	16¾ × "	8·8	11·7	17·5
202A	16½ × "	7·3	9·7	14·5
201A	16¼ × "	5·8	7·7	11·5
200A	16 × "	4·3	5·8	8·6

Rivets ⅝-in. diam.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
188A	18 × 9	15·2	20·2	30·3
186A	17½ × "	12·5	16·6	25·0
184A	17 × "	9·7	12·9	19·4
183A	16¾ × "	8·4	11·2	16·7
182A	16½ × "	7·0	9·3	14·0
181A	16¼ × "	5·6	7·5	11·2
180A	16 × "	4·5	5·9	8·9
179A	15¾ × "	2·9	3·9	5·8

Rivets ⅞-in. diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
172A	18 × 10	21·9	29·2	43·8
170A	17½ × "	19·8	26·3	39·5
168A	17 × "	16·2	21·6	32·4
166A	16½ × "	13·2	17·6	26·4
164A	16 × "	10·3	13·7	20·5
163A	15¾ × "	8·7	11·6	17·3
162A	15½ × "	7·3	9·7	14·6
161A	15¼ × "	5·8	7·7	11·6
160A	15 × "	4·4	5·8	8·7
159A	14¾ × "	3·0	3·9	5·9

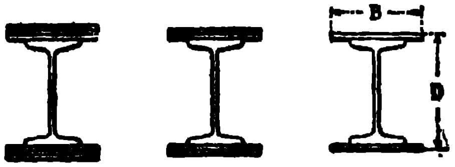
Rivets ¾-in. diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
148A	17 × 10	16·7	22·2	33·3
146A	16½ × "	13·7	18·3	27·4
144A	16 × "	10·7	14·3	21·4
143A	15¾ × "	9·2	12·2	18·3
142A	15½ × "	7·7	10·2	15·3
141A	15¼ × "	6·2	8·2	12·3
140A	15 × "	4·7	6·2	9·3
139A	14¾ × "	3·2	4·3	6·4

Rivets ¾-in. diam.

For safe loads and properties of these girders, see pages 22 to 25.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
132A	16 × 10	21·7	28·9	43·4
130A	15½ × "	18·9	25·2	37·8
128A	15 × "	16·1	21·4	32·1
126A	14½ × "	13·2	17·5	26·3
124A	14 × "	10·2	13·6	20·5
123A	13¾ × "	8·8	11·7	17·5
122A	13½ × "	7·3	9·7	14·6
121A	13¼ × "	5·8	7·8	11·6
120A	13 × "	4·4	5·8	8·7
119A	12¾ × "	3·0	4·0	5·9

Rivets ⅞-in diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
108A	15 × 10	16·5	22·0	33·0
106A	14½ × "	13·6	18·1	27·2
104A	14 × "	10·6	14·1	21·2
103A	13¾ × "	9·1	12·2	18·2
102A	13½ × "	7·6	10·2	15·2
101A	13¼ × "	6·1	8·2	12·2
100A	13 × "	4·7	6·2	9·3
99A	12¾ × "	3·2	4·3	6·4

Rivets ⅞-in. diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
88A	15 × 9	15·3	20·4	30·6
86A	14½ × "	12·7	16·9	25·3
84A	14 × "	10·0	13·3	19·9
83A	13¾ × "	8·6	11·5	17·2
82A	13½ × "	7·3	9·7	14·5
81A	13¼ × "	5·9	7·8	11·7
80A	13 × "	4·5	6·0	9·0
79A	12¾ × "	3·1	4·2	6·2

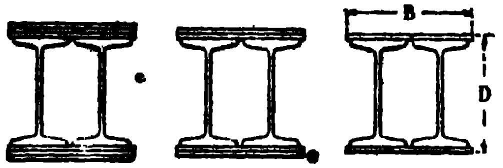
Rivets ¾-in. diam.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
68A	13 × 10	16·3	21·8	32·6
66A	12½ × "	13·4	17·9	26·8
64A	12 × "	10·4	13·9	20·8
63A	11¾ × "	9·1	12·1	18·1
62A	11½ × "	7·6	10·1	15·2
61A	11¼ × "	6·1	8·2	12·2
60A	11 × "	4·6	6·2	9·2
59A	10¾ × "	3·2	4·3	6·4
48A	13 × 9	15·1	20·2	30·2
46A	12½ × "	12·6	16·7	25·1
44A	12 × "	9·9	13·2	19·8
43A	11¾ × "	8·6	11·4	17·2
42A	11½ × "	7·2	9·6	14·4
41A	11¼ × "	5·9	7·8	11·7
40A	11 × "	4·5	6·0	9·0
39A	10¾ × "	3·2	4·2	6·3
28A	11 × 10	16·3	21·7	32·6
26A	10½ × "	13·6	18·1	27·1
24A	10 × "	10·7	14·[illegible]	21·4
23A	9¾ × "	9·3	12·[illegible]	18·5
22A	9½ × "	7·8	10·4	15·6
21A	9¼ × "	6·4	8·5	12·7
20A	9 × "	4·9	6·5	9·7
19A	8¾ × "	3·4	4·5	6·8
14A	10 × 9	9·8	13·0	19·6
13A	9¾ × "	8·5	11·3	17·0
12A	9½ × "	7·2	9·6	14·3
11A	9¼ × "	5·8	7·8	11·7
10A	9 × "	4·5	6·0	9·0
9A	8¾ × "	3·2	4·2	6·3

Rivets ¾-in. diam.

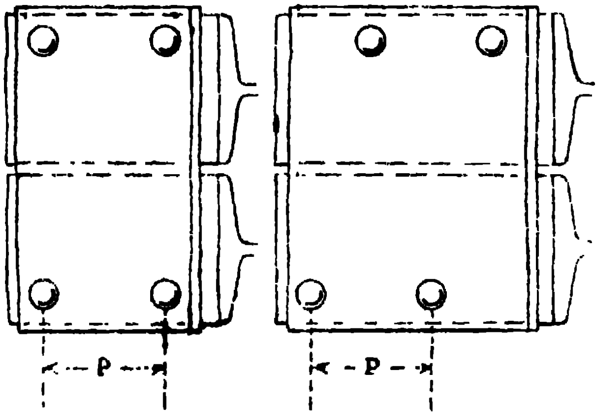
For safe loads and properties of these girders, see pages 26 to 29.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.



Straight Pitch.

Staggered or Reeled Pitch.

P = 3", 4", or 6".

The tables on this and the two following pages give the nearest pitch of rivets in *even* inches which should be adopted if the girders, pages 30 to 39, are used to support the full safe distributed tabular loads in italics.

Example:—Required rivet pitch for girder 288B, page 30, to support tabular load of 240·6 tons on a span of 18 feet.

Answer:—See girder 288B in this table, which gives 3 ins. as the required pitch, the minimum span being 16·5 feet.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of		
		3-in.	4-in.	6-in.
296B	29 × 16	30·1	40·1	60·2
294B	28½ × "	26·7	35·6	53·4
292B	28 × "	23·3	31·1	46·6
290B	27½ × "	19·9	26·5	39·8
288B	27 × "	16·5	22·0	33·0
286B	26½ × "	13·1	17·5	26·2
284B	26 × "	9·8	13·1	19·6
283B	25¾ × "	8·2	10·9	16·4
282B	25½ × "	6·6	8·8	13·2
281B	25¼ × "	5·1	6·8	10·2
280B	25 × "	3·7	4·9	7·3

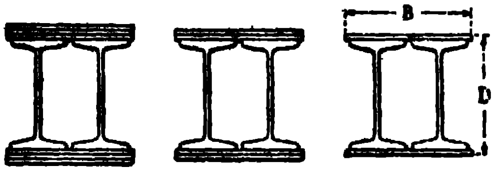
Rivets ⅞-in. diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
276B	25 × 16	30·2	40·2	60·3
274B	24½ × "	26·9	35·8	53·7
272B	24 × "	23·5	31·3	47·0
270B	23½ × "	19·9	26·5	39·8
268B	23 × "	16·7	22·3	33·4
266B	22½ × "	13·4	17·8	26·7
264B	22 × "	10·1	13·4	20·1
263B	21¾ × "	8·4	11·2	16·8
262B	21½ × "	6·8	9·1	13·6
261B	21¼ × "	5·3	7·1	10·6
260B	21 × "	3·8	5·1	7·6

Rivets ⅞-in. diam.

For safe loads and properties of these girders, see pages 30 and 31.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

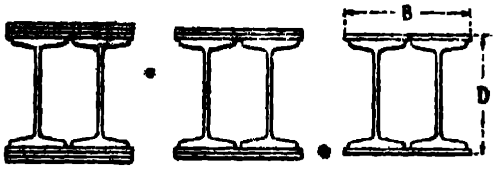
Minimum Spans in Feet for various Rivet Pitches.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
256B	23 × 16	30·8	41·1	61·6
254B	22½ × 〃	27·5	36·6	54·9
252B	22 × 〃	24·1	32·1	48·2
250B	21½ × 〃	20·7	27·6	41·4
248B	21 × 〃	17·3	23·1	34·6
246B	20½ × 〃	13·9	18·6	27·8
244B	20 × 〃	10·5	14·0	21·0
243B	19¾ × 〃	8·9	11·8	17·7
242B	19½ × 〃	7·3	9·7	14·5
241B	19¼ × 〃	5·7	7·5	11·3
240B	19 × 〃	4·1	5·5	8·2
Rivets ⅞-in. diam.				
232B	20 × 14	29·0	38·6	57·9
230B	19½ × 〃	25·0	33·3	49·9
228B	19 × 〃	20·9	27·9	41·9
226B	18½ × 〃	16·9	22·5	33·8
224B	18 × 〃	12·9	17·1	25·7
223B	17¾ × 〃	10·9	14·5	21·7
222B	17½ × 〃	8·9	11·9	17·8
221B	17¼ × 〃	7·0	9·3	13·9
220B	17 × 〃	5·1	6·8	10·2
Rivets ¾-in. diam.				
212B	19 × 14	28·8	38·5	57·6
210B	18½ × 〃	24·8	33·1	49·7
208B	18 × 〃	20·9	27·8	41·8
206B	17½ × 〃	16·8	22·5	33·7
204B	17 × 〃	12·8	17·1	25·6
203B	16¾ × 〃	10·8	14·5	21·6
202B	16½ × 〃	8·9	11·8	17·7
201B	16¼ × 〃	7·0	9·3	13·9
200B	16 × 〃	5·1	6·8	10·2
Rivets ¾-in. diam.				

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
188B	18 × 12	18·7	24·9	37·4
186B	17½ × 〃	15·2	20·3	30·4
184B	17 × 〃	11·7	15·6	23·3
183B	16¾ × 〃	9·9	13·2	19·8
182B	16½ × 〃	8·2	10·9	16·3
181B	16¼ × 〃	6·5	8·6	12·9
180B	16 × 〃	4·8	6·4	9·5
179B	15¾ × 〃	3·2	4·2	6·3
Rivets ¾-in. diam.				
172B	18 × 14	28·8	38·4	57·6
170B	17½ × 〃	24·9	33·1	49·7
168B	17 × 〃	20·9	27·9	41·8
166B	16½ × 〃	16·9	22·5	33·7
164B	16 × 〃	12·9	17·2	25·7
163B	15¾ × 〃	10·9	14·5	21·8
162B	15½ × 〃	8·9	11·9	17·8
161B	15¼ × 〃	7·0	9·3	14·0
160B	15 × 〃	5·1	6·8	10·2
159B	14¾ × 〃	3·4	4·5	6·7
Rivets ¾-in. diam.				
148B	17 × 14	21·8	29·0	43·5
146B	16½ × 〃	17·7	23·6	35·4
144B	16 × 〃	13·6	18·2	27·2
143B	15¾ × 〃	11·6	15·5	23·2
142B	15½ × 〃	9·6	12·7	19·1
141B	15¼ × 〃	7·6	10·1	15·1
140B	15 × 〃	5·6	7·5	11·2
139B	14¾ × 〃•	3·8	5·0	7·5
Rivets ¾-in. diam.				

For safe loads and properties of these girders, see pages 32 to 35.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.

Reference Mark.	Size, D x B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
132B	16 x 14	28·6	38·2	57·2
130B	15½ x "	24·7	32·9	49·3
128B	15 x "	20·8	27·7	41·5
126B	14½ x "	16·8	22·5	33·7
124B	14 x "	12·9	17·1	25·7
123B	13¾ x "	10·9	14·5	21·8
122B	13½ x "	8·9	11·9	17·8
121B	13¼ x "	7·0	9·4	14·0
120B	13 x "	5·1	6·9	10·3
119B	12¾ x "	3·4	4·5	6·7

Rivets ¾-in. diam.

Reference Mark.	Size, D x B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
108B	15 x 14	21·6	28·8	43·1
106B	14½ x "	17·6	23·5	35·2
104B	14 x "	13·5	18·1	27·1
103B	13¾ x "	11·5	15·4	23·0
102B	13½ x "	9·5	12·7	19·0
101B	13¼ x "	7·6	10·0	15·1
100B	13 x "	5·6	7·5	11·2
99B	12¾ x "	3·7	5·0	7·4

Rivets ¾-in. diam.

Reference Mark.	Size, D x B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
88B	15 x 12	19·1	25·5	38·2
86B	14½ x "	15·7	20·9	31·3
84B	14 x "	12·1	16·2	24·3
83B	13¾ x "	10·4	13·8	20·8
82B	13½ x "	8·6	11·5	17·2
81B	13¼ x "	6·9	9·2	13·7
80B	13 x "	5·2	6·9	10·3
79B	12¾ x "	3·5	4·6	6·9

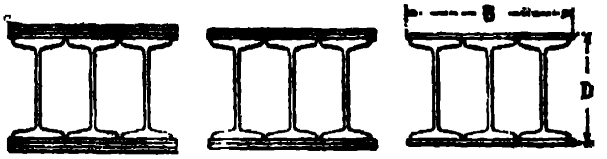
Rivets ¾-in. diam.

Reference Mark.	Size, D x B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
68B	13 x 14	21·3	28·4	42·6
66B	12½ x "	17·4	23·2	34·8
64B	12 x "	13·5	18·0	26·9
63B	11¾ x "	11·5	15·3	22·9
62B	11½ x "	9·5	12·7	19·0
61B	11¼ x "	7·5	10·0	15·0
60B	11 x "	5·6	7·5	11·2
59B	10¾ x "	3·8	5·0	7·5
48B	13 x 12	18·9	25·3	37·9
46B	12½ x "	15·6	20·7	31·1
44B	12 x "	12·1	16·1	24·2
43B	11¾ x "	10·4	13·8	20·7
42B	11½ x "	8·6	11·5	17·2
41B	11¼ x "	6·9	9·2	13·8
40B	11 x "	5·2	6·9	10·3
39B	10¾ x "	3·5	4·7	7·0
28B	11 x 14	21·6	28·8	43·2
26B	10½ x "	17·8	23·7	35·5
24B	10 x "	13·9	18·5	27·7
23B	9¾ x "	11·9	15·9	23·8
22B	9½ x "	9·9	13·2	19·8
21B	9¼ x "	8·0	10·6	15·9
20B	9 x "	6·0	8·0	12·0
19B	8¾ x "	4·1	5·4	8·1
14B	10 x 12	12·0	16·0	23·9
13B	9¾ x "	10·3	13·7	20·5
12B	9½ x "	8·6	11·4	17·1
11B	9¼ x "	6·9	9·1	13·7
10B	9 x "	5·2	6·9	10·3
9B	8¾ x "	3·5	4·7	7·0

Rivets ¾-in. diam.

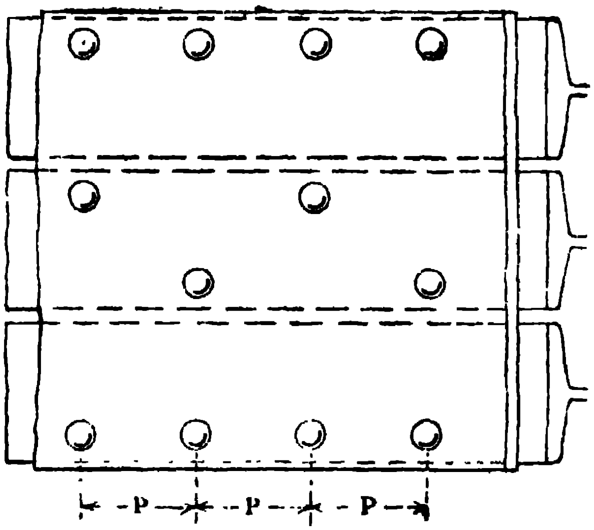
For safe loads and properties of these girders, see pages 36 to 39.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.



P = 3″, 4″, or 6″.

The tables on this and the two following pages give the nearest pitch of rivets in even inches, spaced as shown on sketch, which should be adopted if the girders, pages 40 to 49, are used to support the full safe distributed tabular loads in italics.

Example:—Required rivet pitch for girder 264C, page 40, to support tabular load of 298 tons on a span of 14 feet.

Answer:—See girder 264C in this table, which gives 4 ins. as the required pitch, the minimum span being 13·4 feet.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of		
		3-in.	4-in.	6-in.
296C	29 × 24	30·1	40·1	60·2
294C	28½ × "	26·7	35·6	53·4
292C	28 × "	23·3	31·1	46·6
290C	27½ × "	19·9	26·5	39·7
288C	27 × "	16·5	22·0	32·9
286C	26½ × "	13·1	17·5	26·2
284C	26 × "	9·8	13·1	19·6
283C	25¾ × "	8·2	10·9	16·4
282C	25½ × "	6·6	8·8	13·2
281C	25¼ × "	5·1	6·8	10·2
280C	25 × "	3·7	4·9	7·3

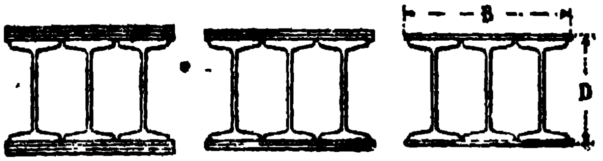
Rivets ⅞-in. diam.

Reference Mark.	Size, D × B inches.	3-in.	4-in.	6-in.
276C	25 × 24	30·2	40·2	60·4
274C	24½ × "	26·8	35·8	53·6
272C	24 × "	23·5	31·3	46·9
270C	23½ × "	20·1	26·8	40·2
268C	23 × "	16·7	22·3	33·4
266C	22½ × "	13·2	17·6	26·4
264C	22 × "	10·1	13·4	20·1
263C	21¾ × "	8·4	11·2	16·8
262C	21½ × "	6·8	9·1	13·6
261C	21¼ × "	5·3	7·0	10·5
260C	21 × "	4·0	5·3	7·9

Rivets ⅞-in. diam.

For safe loads and properties of these girders, see pages 40 and 41.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

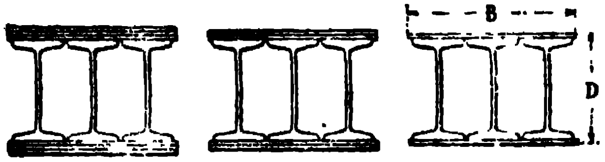
Minimum Spans in Feet for various Rivet Pitches.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of		
		3-in.	4-in.	6-in.
256C	23 × 24	30·8	41·1	61·6
254C	22½ × "	26·5	35·2	52·9
252C	22 × "	24·1	32·1	48·2
250C	21½ × "	20·7	27·6	41·4
248C	21 × "	17·3	23·1	34·6
246C	20½ × "	13·9	18·5	27·8
244C	20 × "	10·5	14·0	21·0
243C	19¾ × "	8·9	11·8	17·7
242C	19½ × "	7·3	9·7	14·5
241C	19¼ × "	5·6	7·5	11·2
240C	19 × "	4·1	5·5	8·2
	Rivets ⅞-in. diam.			
232C	20 × 21	28·9	38·5	57·7
230C	19½ × "	25·0	33·3	49·9
228C	19 × "	20·9	27·9	41·8
226C	18½ × "	16·9	22·5	33·7
224C	18 × "	12·9	17·1	25·7
223C	17¾ × "	10·9	14·5	21·7
222C	17½ × "	8·9	11·9	17·8
221C	17¼ × "	7·0	9·3	13·9
220C	17 × "	5·6	7·5	11·1
	Rivets ¾-in. diam.			
212C	19 × 21	28·9	38·5	57·7
210C	18½ × "	24·9	33·2	49·8
208C	18 × "	20·9	27·8	41·7
206C	17½ × "	16·9	22·5	33·7
204C	17 × "	12·8	17·1	25·6
203C	16¾ × "	10·8	14·4	21·7
202C	16½ × "	8·9	11·9	17·7
201C	16¼ × "	7·0	9·3	13·9
200C	16 × "	5·6	7·5	11·1
	Rivets ¾-in. diam.			

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of		
		3-in.	4-in.	6-in.
188C	18 × 18	18·7	25·0	37·4
186C	17½ × "	15·2	20·3	30·4
184C	17 × "	11·7	15·6	23·3
183C	16¾ × "	9·9	13·2	19·8
182C	16½ × "	8·2	10·9	16·3
181C	16¼ × "	6·4	8·6	12·9
180C	16 × "	4·8	6·4	9·5
179C	15¾ × "	3·2	4·2	6·3
	Rivets ¾-in. diam.			
172C	18 × 20	27·1	36·2	54·2
170C	17½ × "	23·4	31·2	46·8
168C	17 × "	19·6	26·1	39·2
166C	16½ × "	15·8	21·1	31·6
164C	16 × "	12·9	17·2	25·9
163C	15¾ × "	10·2	13·6	20·3
162C	15½ × "	8·3	11·1	16·6
161C	15¼ × "	6·5	8·6	13·0
160C	15 × "	4·7	6·3	9·5
159C	14¾ × "	3·1	4·1	6·1
	Rivets ¾-in. diam.			
148C	17 × 20	20·5	27·4	41·0
146C	16½ × "	16·7	22·2	33·3
144C	16 × "	13·4	17·9	26·8
143C	15¾ × "	10·9	14·5	21·7
142C	15½ × "	8·9	11·9	17·8
141C	15¼ × "	7·1	9·4	14·1
140C	15 × "	5·2	7·0	10·4
139C	14¾ × "	3·5	4·6	6·9
	Rivets ¾-in. diam.			

For safe loads and properties of these girders, see pages 42 to 45.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
132C	16 × 20	26·9	35·9	53·8
130C	15½ × "	23·3	31·0	46·5
128C	15 × "	19·5	26·0	39·0
126C	14½ × "	15·8	21·1	31·6
124C	14 × "	12·0	16·0	24·0
123C	13¾ × "	10·2	13·6	20·3
122C	13½ × "	8·3	11·1	16·6
121C	13¼ × "	6 5	8·7	13·0
120C	13 × "	4·8	6·4	9·5
119C	12¾ × "	3·1	4·1	6·2
Rivets ⅞-in. diam.				
108C	15 × 20	20 3	27·1	40·6
106C	14½ × "	16·6	22·1	33·1
104C	14 × "	12·7	17·0	25·4
103C	13¾ × "	10·8	14·4	21·6
102C	13½ × "	8·9	11·9	17·8
101C	13¼ × "	7·0	9·3	14·0
100C	13 × "	5·2	6·9	10·4
99C	12¾ × "	3·5	4·6	6·9
Rivets ⅞-in. diam.				
88C	15 × 18	19·1	25·5	38·2
86C	14½ × "	15·7	20·9	31·4
84C	14 × "	12·2	16·2	24·3
83C	13¾ × "	10·4	13·8	20·8
82C	13½ × "	8·6	11·5	17·2
81C	13¼ × "	6·9	9·2	13·7
80C	13 × "	5·2	6·9	10·3
79C	12¾ × "	3·5	4·6	6·9
Rivets ¾-in. diam.				

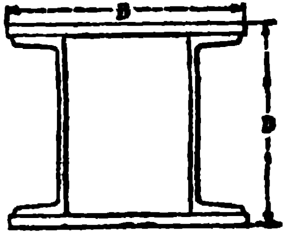
Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of 3-in.	4-in.	6-in.
68C	13 × 20	20·1	26·8	40·2
66C	12½ × "	16·4	21·8	32·8
64C	12 × "	12·6	16·8	25·2
63C	11¾ × "	10·7	14·3	21·5
62C	11½ × "	8·9	11·8	17·7
61C	11¼ × "	7·0	9·4	14·0
60C	11 × "	5·2	6·9	10·4
59C	10¾ × "	3·5	4·6	6·9
48C	13 × 18	19·0	25·3	37·9
46C	12½ × "	15·6	20·7	31·1
44C	12 × "	12·1	16·1	24·2
43C	11¾ × "	10·4	13·8	20·7
42C	11½ × "	8·6	11·5	17·2
41C	11¼ × "	6·9	9·2	13·8
40C	11 × "	5·2	6·9	10·3
39C	10¾ × "	3·5	4·7	7·0
28C	11 × 20	20·4	27·2	40·7
26C	10½ × "	16·8	22·4	33·5
24C	10 × "	13·1	17·4	26·1
23C	9¾ × "	11·2	14·9	22·4
22C	9½ × "	9·3	12·4	18·6
21C	9¼ × "	7·4	9·9	14·8
20C	9 × "	5·6	7·4	11·1
19C	8¾ × "	3·8	5·0	7·5
14C	10 × 18	12·0	16·0	23·9
13C	9¾ × "	10·3	13·7	20·5
12C	9½ × "	8·6	11·4	17·1
11C	9¼ × "	6·9	9·1	13·7
10C	9 × "	5·2	6·9	10·3
9C	8¾ × "	3·5	4·6	7·0
Rivets ¾-in. diam.				

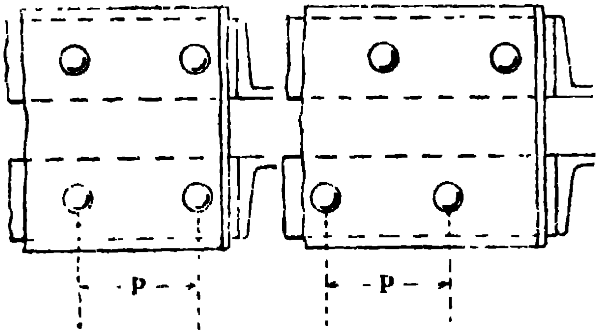
For safe loads and properties of these girders, see pages 46 to 49.

For full explanations of tables, see notes commencing page 108.

COMPOUND GIRDERS.

Minimum Spans in Feet for various Rivet Pitches.





Straight Pitch. **Staggered or Reeled Pitch.**

P = 3″, 4″, or 6″.

The tables on this page give the nearest pitch of rivets in *even* inches which should be adopted if the girders, pages 74-75, are used to support the full safe distributed tabular loads in italics.

Example:—Required rivet pitch for girder 15E, page 74, to support tabular load of 51·7 tons on a span of 10 feet.

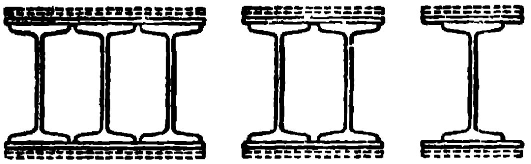
Answer:—See girder 15E in this table, which gives 4 ins. as the required pitch, the minimum span being 9·9 feet.

Reference Mark.	Size, D × B inches.	Minimum Spans in Feet for Rivet Pitches of		
		3-in.	4-in.	6-in.
29E	16½ × 16	12·5	16·7	25·0
28E	16¼ × ″	10·1	13·4	20·1
27E	16 × ″	7·7	10·2	15·3
26E	16½ × 12	8·7	11·5	17·3
25E	16¼ × ″	6·9	9·2	13·8
24E	16 × ″	5·2	6·9	10·3
23E	13½ × 16	13·7	18·2	27·3
22E	13¼ × ″	10·5	14·0	21·0
21E	13 × ″	8·1	10·7	16·1
20E	13¼ × 12	7·3	9·7	14·5
19E	13 × ″	5·5	7·4	11·0
18E	11½ × 16	13·1	17·5	26·2
17E	11¼ × ″	10·7	14·2	21·3
16E	11 × ″	8·2	11·0	16·4
15E	11¼ × 12	7·4	9·9	14·8
14E	11 × ″	5·7	7·5	11·3
13E	10½ × 16	13·2	17·6	26·3
12E	10¼ × ″	10·8	14·3	21·5
11E	10 × ″	8·3	11·1	16·6
10E	10¼ × 12	7·5	10·0	15·0
9E	10 × ″	5·8	7·7	11·5
8E	9¼ × 16	10·8	14·5	21·7
7E	9 × ″	8·4	11·2	16·8
6E	9¼ × 12	7·6	10·1	15·2
5E	9 × ″	5·9	7·8	11·7
4E	8¼ × 16	10·9	14·6	21·8
3E	8 × ″	8·5	11·4	17·0
2E	8¼ × 12	7·7	10·2	15·4
1E	8 × ″	5·9	7·9	11·8

Rivets ¾-in. diam.

For safe loads and properties of these girders, see pages 74 and 75.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.

Composed of			Weight per foot in lbs.	Maximum Moment of Resistance, in foot tons.	Composed of			Weight per foot in lbs.	Maximum Moment of Resistance, in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.			1 2 3	Steel Joist(s).	Plates, each Flange to form.		
3	24 × 7½	24 × 2½	713½	1114·2	3	24 × 7½	24 × ⅝	407½	554·9
3	24 × 7½	24 × 2¼	672½	1037·6	3	18 × 7	24 × 1½	475½	543·4
3	24 × 7½	24 × 2	632	961·8	2	24 × 7½	16 × 1½	367	541·3
3	20 × 7½	24 × 2½	680½	898·9	1	24 × 7½	12 × 2½	308	523·1
3	24 × 7½	24 × 1¾	591	886·6	3	20 × 7½	24 × 1	435½	522·2
3	20 × 7½	24 × 2¼	639½	834·5	3	24 × 7½	24 × ½	387	518·7
3	24 × 7½	24 × 1½	550	811·9	2	18 × 7	16 × 2½	426	516·6
3	18 × 7	24 × 2½	638½	774·9	2	20 × 7½	16 × 2	399½	513·8
3	20 × 7½	24 × 2	599	770·8	3	16 × 6	21 × 2	475	498·9
2	24 × 7½	16 × 2½	475½	742·6	2	24 × 7½	16 × 1¼	339½	491·9
3	24 × 7½	24 × 1¼	509½	737·9	3	20 × 7½	24 × ⅞	415½	491·8
3	18 × 7	24 × 2¼	598	716·1	3	18 × 7	24 × 1¼	434½	487·1
3	20 × 7½	24 × 1¾	558	707·6	1	24 × 7½	12 × 2¼	287½	482·2
2	24 × 7½	16 × 2¼	448½	691·4	2	18 × 7	16 × 2¼	398½	477·3
3	24 × 7½	24 × 1	468½	664·3	2	20 × 7½	16 × 1¾	372	471·7
3	18 × 7	24 × 2	557	657·8	3	15 × 6	21 × 2	466	464·9
3	20 × 7½	24 × 1½	517½	645·3	3	20 × 7½	24 × 0¾	395	461·5
2	24 × 7½	16 × 2	421½	641·2	3	16 × 6	21 × 1¾	439½	453·7
3	24 × 7½	24 × ⅞	448	627·8	2	24 × 7½	16 × 1	312½	442·8
3	18 × 7	24 × 1¾	516½	600·2	1	24 × 7½	12 × 2	267	441·5
2	20 × 7½	16 × 2½	453½	599·3	2	18 × 7	16 × 2	371½	438·5
3	24 × 7½	24 × ¾	428	591·3	3	20 × 7½	24 × ⅝	374½	431·4
2	24 × 7½	16 × 1¾	394	591·0	3	18 × 7	24 × 1	394	431·4
3	20 × 7½	24 × 1¼	476½	583·4	2	20 × 7½	16 × 1½	345	430·1
2	20 × 7½	16 × 2¼	426½	556·3	1	20 × 7½	12 × 2½	297	426·7

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows:—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed "Maximum Moment of Resistance, foot tons."

Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

Safe working stress = 7·5 tons per square inch.

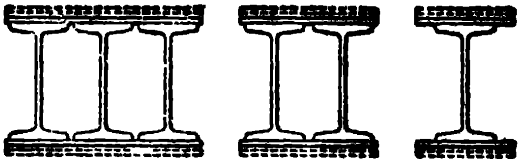
Note deflection, web-buckling, and rivet-pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.

COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.



Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.	Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.			1 2 3	Steel Joist(s).	Plates, each Flange to form.		
3	15 × 6	21 × 1¾	430½	422·3	3	15 × 6	21 × 1¼	360	339·0
2	24 × 7½	16 × ⅞	299	418·5	3	14 × 6*a*	20 × 1½	378½	337·7
3	14 × 6*a*	20 × 2	446½	412·4	2	16 × 6	14 × 2	317	332·6
3	16 × 6	21 × 1½	403½	409·1	2	20 × 7½	16 × ⅞	277	327·8
3	18 × 7	24 × ⅞	373½	403·7	2	18 × 7	16 × 1¼	290	324·6
3	20 × 7½	24 × ½	354	401·3	1	20 × 7½	12 × 1¾	235½	324·1
1	24 × 7½	12 × 1¾	246½	401·2	3	18 × 7	24 × ½	312½	321·6
2	18 × 7	16 × 1¾	344½	400·1	3	16 × 6	21 × 1	332½	321·5
2	24 × 7½	16 × ¾	285½	394·2	1	24 × 7½	12 × 1¼	206	321·2
1	20 × 7½	12 × 2¼	276½	392·2	3	14 × 6*b*	20 × 1½	345½	319·8
2	20 × 7½	16 × 1¼	317½	389·0	3	12 × 6*a*	20 × 1¾	403½	315·9
3	15 × 6	21 × 1½	395	380·5	1	18 × 7	12 × 2	242	310·5
3	18 × 7	24 × ¾	353	376·2	2	15 × 6	14 × 2	311	309·9
3	14 × 6*a*	20 × 1¾	412½	374·7	2	20 × 7½	16 × ¾	263½	307·6
1	18 × 7	12 × 2½	283	373·1	2	16 × 6	14 × 1¾	293	302·5
2	24 × 7½	16 × ⅝	271½	369·9	3	14 × 6*a*	20 × 1¼	344½	301·3
3	16 × 6	21 × 1¼	368	365·1	3	16 × 6	21 × ⅞	314½	299·9
2	18 × 7	16 × 1½	317	362·2	3	15 × 5	18 × 1½	313	299·2
1	24 × 7½	12 × 1½	226	361·1	3	15 × 6	21 × 1	323½	298·2
1	20 × 7½	12 × 2	256	358·0	1	20 × 7½	12 × 1½	215	290·5
3	18 × 7	24 × ⅝	332½	348·8	2	20 × 7½	16 × ⅝	249½	287·5
3	12 × 6*a*	20 × 2	437½	348·5	2	18 × 7	16 × 1	262½	287·5
2	20 × 7½	16 × 1	290½	348·1	2	14 × 6*a*	14 × 2	307	286·8
2	24 × 7½	16 × ½	258	345·8	3	12 × 6*a*	20 × 1½	369½	283·8
1	18 × 7	12 × 2¼	262½	341·5	3	14 × 6*b*	20 × 1¼	311½	282·8

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows:—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed "Maximum Moment of Resistance, foot tons."

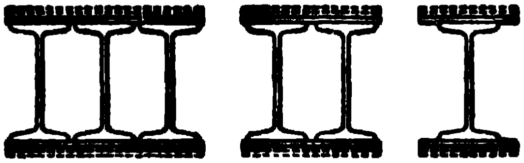
Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

Safe working stress = 7·5 tons per square inch.

Note deflection, web-buckling, and rivet-pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.

Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.	Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.			1 2 3	Steel Joist(s).	Plates, each Flange to form.		
1	24 × 7½	12 × 1	185½	281·5	3	12 × 6*b*	20 × 1¼	305½	239·5
2	15 × 6	14 × 1¾	287	281·5	3	15 × 6	21 × ⅝	270	238·0
1	18 × 7	12 × 1¾	221½	279·6	3	16 × 6	21 × ½	261	235·9
3	16 × 6	21 × ¾	296½	278·5	2	14 × 6*a*	14 × 1½	259½	234·0
3	15 × 6	21 × ⅞	305½	278·0	2	18 × 7	16 × ⅝	222	232·5
2	16 × 6	14 × 1½	269	272·7	3	14 × 6*a*	20 × ¾	276½	230·1
3	12 × 6*b*	20 × 1½	339½	270·7	3	15 × 5	18 × 1	252	229·2
2	18 × 7	16 × ⅞	249	269·1	3	14 × 6*b*	20 × ⅞	260½	228·3
2	20 × 7½	16 × ½	236	267·5	1	16 × 6	10 × 2	200½	227·3
3	14 × 6*a*	20 × 1	310½	265·4	2	15 × 6	14 × 1¼	239½	226·0
3	15 × 5	18 × 1¼	282½	264·0	3	12 × 5	18 × 1½	283	225·7
1	24 × 7½	12 × ⅞	175	261·8	1	20 × 7½	12 × 1	174½	224·2
2	14 × 6*a*	14 × 1¾	283	260·2	1	24 × 7½	12 × ⅝	155	222·5
3	15 × 6	21 × ¾	287½	257·9	3	10 × 6	20 × 1½	333½	222·2
1	20 × 7½	12 × 1¼	195	257·2	3	12 × 6*a*	20 × 1	301½	221·7
3	16 × 6	21 × ⅝	279	257·1	2	14 × 6*b*	14 × 1½	237½	220·8
2	15 × 6	14 × 1½	263½	253·5	2	12 × 6*a*	14 × 1¾	277	219·5
3	12 × 6*a*	20 × 1¼	335½	253·2	1	18 × 7	12 × 1¼	181	218·9
2	18 × 7	16 × ¾	235½	250·8	3	15 × 6	21 × ½	252	218·1
1	18 × 7	12 × 1½	201	249·1	2	18 × 7	16 × ½	208½	214·3
3	14 × 6*a*	20 × ⅞	293½	247·7	2	16 × 6	14 × 1	221½	214·3
3	14 × 6*b*	20 × 1	277½	246·4	3	14 × 6*a*	20 × ⅝	259½	212·5
2	16 × 6	14 × 1¼	245½	243·3	1	15 × 6	10 × 2	197½	212·2
2	12 × 6*a*	14 × 2	301	242·6	3	15 × 5	18 × ⅞	236½	211·9
1	24 × 7½	12 × ¾	165	242·1	3	14 × 6*b*	20 × ¾	243½	210·4

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows :—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed " Maximum Moment of Resistance, foot tons."

Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

Safe working stress = 7·5 tons per square inch.

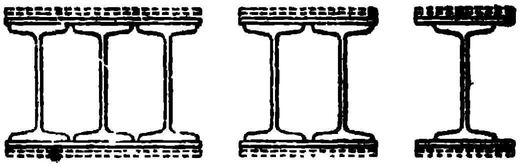
Note deflection, web-buckling, and rivet pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.

COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.



Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.	Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.			1 2 3	Steel Joist(s).	Plates, each Flange to form.		
2	14 × 6*a*	14 × 1¼	235½	208·2	2	15 × 6	14 × ⅞	204	185·3
1	20 × 7½	12 × ⅞	164	207·7	2	14 × 6*a*	14 × 1	211½	182·8
3	12 × 6*b*	20 × 1	271½	207·5	1	16 × 6	10 × 1½	166½	181·8
3	12 × 6*a*	20 × ⅞	284½	206·5	3	14 × 6*a*	20 × ⅝	225½	177·9
1	16 × 6	10 × 1¾	183½	204·4	3	15 × 5	18 × ⅝	206	177·7
1	24 × 7½	12 × ½	144½	202·9	1	14 × 6*a*	10 × 1¾	178½	176·8
2	16 × 6	14 × ⅞	209½	199·9	3	12 × 6*b*	20 × ¾	237½	176·7
2	15 × 5	12 × 1½	209	199·5	3	12 × 6*a*	20 × ⅝	250½	176·5
2	15 × 6	14 × 1	215½	198·8	2	15 × 5	12 × 1¼	188½	176·0
3	12 × 5	18 × 1¼	252½	197·7	2	12 × 6*a*	14 × 1¼	229½	175·1
1	14 × 6*a*	10 × 2	195½	197·0	1	20 × 7½	12 × ⅝	144	175·1
2	12 × 6*a*	14 × 1½	253½	196·9	3	14 × 6*b*	20 × ½	209½	174·9
2	14 × 6*b*	14 × 1¼	213½	195·9	1	18 × 7	12 × ⅞	150	174·0
3	10 × 6	20 × 1¼	299½	195·4	2	15 × 6	14 × ¾	192	171·9
3	14 × 6*a*	20 × ½	242½	195·2	2	16 × 6	14 × ⅝	186	171·4
3	15 × 5	18 × ¾	221½	194·8	2	14 × 6*a*	14 × ⅞	200	170·2
3	14 × 6*b*	20 × ⅝	226½	192·5	2	14 × 6*b*	14 × 1	189½	170·1
3	12 × 6*b*	20 × ⅞	254½	192·1	1	15 × 6	10 × 1½	163½	169·4
3	12 × 6*a*	20 × ¾	267½	191·4	3	8 × 6	20 × 1½	312½	169·4
1	20 × 7½	12 × ¾	154	191·4	3	10 × 6	20 × 1	265½	169·2
1	15 × 6	10 × 1¾	180½	190·7	3	12 × 5	18 × 1	222	168·8
1	18 × 7	12 × 1	160½	188·9	1	12 × 6*a*	10 × 2	192½	167·6
2	12 × 6*b*	14 × 1½	233½	188·0	2	12 × 6*b*	14 × 1¼	209½	166·0
2	16 × 6	14 × ¾	198	185·6	3	12 × 6*a*	20 × ½	233½	161·7
3	10 × 5	18 × 1½	277	185·6	3	12 × 6*b*	20 × ⅝	220½	161·6

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows :—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed "Maximum Moment of Resistance, foot tons."

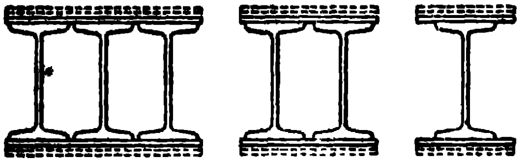
Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

Safe working stress = 7·5 tons per square inch.

Note deflection, web-buckling, and rivet-pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.

Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.	Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.			1 2 3	Steel Joist(s).	Plates, each Flange to form.		
3	10×5	18×1¼	246½	161·4	2	14×6*b*	14× ¾	166	144·7
3	15×5	18× ½	191	160·7	1	18×7	12× ⅝	130	144·4
1	16×6	10×1¼	149½	159·4	3	15×5	18× ⅝	175½	143·9
1	18×7	12× ¾	140	159·2	3	10×6	20× ¾	231½	143·7
1	20×7½	12× ½	133½	158·8	2	12×6*b*	14×1	185½	143·4
2	15×6	14× ⅝	180	158·6	1	15×5	9×1½	136	142·4
2	14×6*a*	14× ¾	188	157·7	2	12×6*a*	14× ⅞	194	142·1
2	14×6*b*	14× ⅞	178½	157·4	2	15×5	12× ⅞	158	141·3
2	16×6	14× ½	174	157·3	3	12×5	18× ¾	191½	141·0
3	14×6*b*	20× ⅝	192½	157·2	3	10×5	18×1	216	137·7
1	14×6*a*	10×1½	161½	156·9	1	16×6	10×1	132½	137·3
3	10×6	20× ⅞	248½	156·4	1	14×6*a*	10×1¼	144½	137·2
3	12×5	18× ⅞	206½	154·9	2	10×6	14×1¼	205½	135·6
2	10×6	14×1¼	229½	154·6	2	14×6*a*	14× ½	164½	133·1
2	15×5	12×1	168	152·8	1	12×6*a*	10×1½	158½	132·7
2	12×6*a*	14×1	205½	152·8	2	12×6*b*	14× ⅞	174	132·5
1	14×6*b*	10×1½	150½	150·9	2	14×6*b*	14× ⅝	154	132·0
2	12×5	12×1½	189	150·5	2	12×5	12×1¼	168½	131·8
1	12×6*a*	10×1¾	175½	150·0	3	12×6*b*	20× ⅝	186½	131·6
1	15×6	10×1¼	146½	148·4	2	12×6*a*	14× ¾	182	131·4
3	8×6	20×1¼	278½	147·3	1	14×6*b*	10×1¼	133½	131·1
3	12×6*a*	20× ⅝	216½	147·0	3	10×6	20× ⅝	214½	131·1
3	12×6*b*	20× ½	203½	146·5	2	15×5	12× ¾	147½	129·9
2	15×6	14× ½	168	145·4	1	18×7	12× ½	119½	129·7
2	14×6*a*	14× ⅝	176	145·4	1	12×6*b*	10×1½	148½	128·3

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows:—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed "Maximum Moment of Resistance, foot tons."

Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

Safe working stress = 7·5 tons per square inch.

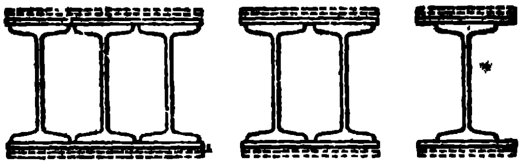
Note deflection, web-buckling, and rivet-pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.

COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.



Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.	Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.			1 2 3	Steel Joist(s).	Plates, each Flange to form.		
1	15 × 6	10 × 1	129½	127·7	2	12 × 6*b*	14 × ⅝	150	110·9
3	12 × 5	18 × ⅝	176	127·2	2	12 × 6*a*	14 × ½	158	110·3
1	16 × 6	10 × ⅞	124	126·3	1	12 × 5	9 × 1½	126½	109·6
3	10 × 5	18 × ⅞	200½	126·0	1	14 × 6*a*	10 × ⅞	119	108·2
3	8 × 6	20 × 1	244½	125·9	2	10 × 6	14 × ⅞	170	107·9
2	10 × 5	12 × 1½	185	123·7	3	8 × 5	18 × 1	210	107·8
1	15 × 5	9 × 1¼	121	123·4	2	10 × 5	12 × 1¼	164½	107·6
2	12 × 6*b*	14 × ¾	162	121·6	2	15 × 5	12 × ½	127½	107·2
2	12 × 6*a*	14 × ⅝	170	120·8	1	15 × 6	10 × ¾	112½	107·1
2	14 × 6*a*	14 × ⅜	152	120·7	2	14 × 6*b*	14 × ⅜	130	107·0
2	14 × 6*b*	14 × ½	142	119·5	3	10 × 6	20 × ⅜	180½	106·3
3	10 × 6	20 × ½	197½	118·6	1	10 × 6	10 × 1½	146½	106·0
2	15 × 5	12 × ⅝	137½	118·5	3	8 × 6	20 × ¾	210½	105·0
2	8 × 6	14 × 1½	215½	118·2	1	15 × 5	9 × 1	105½	104·7
1	14 × 6*a*	10 × 1	127½	117·8	1	16 × 6	10 × ⅝	107	104·5
1	15 × 6	10 × ⅞	121	117·4	2	12 × 5	12 × ⅞	138	103·2
2	10 × 6	14 × 1	181½	117·1	3	10 × 5	18 × ⅝	170	103·0
1	12 × 6*a*	10 × 1¼	141½	116·1	2	8 × 6	14 × 1¼	191½	102·5
1	16 × 6	10 × ¾	115½	115·4	1	14 × 6*b*	10 × ⅞	108	101·7
3	8 × 6	20 × ⅞	227½	115·4	2	12 × 6*b*	14 × ½	138	100·2
3	10 × 5	18 × ¾	185½	114·4	3	12 × 5	18 × ⅜	145½	100·0
3	12 × 5	18 × ½	161	113·6	2	12 × 6*a*	14 × ⅜	146	99·9
2	12 × 5	12 × 1	148	112·6	1	12 × 6*a*	10 × 1	125	99·1
1	12 × 6*b*	10 × 1¼	131½	111·6	2	10 × 6	14 × ¾	158	98·9
1	14 × 6*b*	10 × 1	116½	111·4	1	14 × 6*a*	10 × ¾	110½	98·6

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows:—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed "Maximum Moment of Resistance, foot tons."

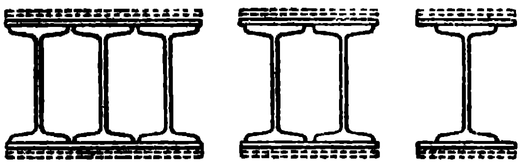
Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

Safe working stress = 7·5 tons per square inch.

Note deflection, web-buckling, and rivet-pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.



COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.

1 2 3	Composed of Steel Joist(s).	Plates, each Flange to form.	Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.	1 2 3	Composed of Steel Joist(s).	Plates, each Flange to form.	Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.
3	8×5	18× ⅞	195	98·4	2	10×5	12× ⅞	134	84·0
1	15×6	10× ⅝	104	96·9	1	12×6*a*	10× ¾	107½	82·6
2	15×5	12× ⅜	117	95·9	1	14×6*b*	10× ⅝	91	82·4
1	15×5	9× ⅞	98	95·4	1	8×6	10×1½	139½	82·3
3	8×6	20× ⅝	193½	94·8	2	10×6	14× ½	134	81·2
1	12×5	9×1¼	111	94·5	3	10×5	18× ⅜	139½	80·4
1	12×6*b*	10×1	114½	94·4	3	8×5	18× ⅝	164	80·0
2	12×5	12× ¾	127½	94·0	2	8×6	14× ⅞	156	79·9
1	16×6	10× ½	98½	93·6	1	14×6*a*	10× ½	93½	79·6
1	14×6*b*	10× ¾	99½	92·1	1	12×5	9×1	95½	78·9
2	10×5	12×1	144	91·7	1	12×6*b*	10× ¾	97½	77·7
3	10×5	18× ½	155	91·7	1	10×5	9×1¼	109	77·6
1	10×6	10×1¼	129½	91·6	1	10×6	10×1	112½	77·5
1	12×6*a*	10× ⅞	116	90·8	1	15×5	9× ⅝	82½	76·9
1	10×5	9×1½	124½	90·6	2	10×5	12× ¾	123½	76·3
2	10×6	14× ⅝	146	90·0	2	12×5	12× ½	107½	75·7
2	12×6*b*	14× ⅜	126	89·6	3	8×6	20× ⅜	159½	74·9
1	14×6*a*	10× ⅝	102	89·1	1	12×6*a*	10× ⅝	99	74·5
3	8×5	18× ¾	179½	89·1	1	14×6*b*	10× ½	82½	72·9
2	8×6	14×1	167½	87·3	2	8×6	14× ¾	144	72·6
1	15×6	10× ½	95½	86·8	2	10×6	14× ⅜	122	72·4
1	15×5	9× ¾	90½	86·1	2	8×5	12×1	140	71·9
1	12×6*b*	10× ⅞	106	86·1	1	12×5	9× ⅞	88	71·4
2	12×5	12× ⅝	117½	84·8	3	8×5	18× ½	149	70·9
3	8×6	20× ½	176½	84·7	1	10×6	10× ⅞	104	70·5

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows :—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed "Maximum Moment of Resistance, foot tons."

Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

Safe working stress=7·5 tons per square inch.

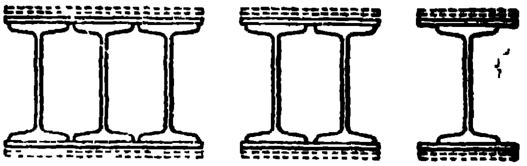
Note deflection, web-buckling, and rivet-pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.

COMPOUND GIRDERS.

Arranged in Descending Order of Carrying Capacity.



Composed of			Weight per foot in lbs	Maximum Moment of Resistance in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.		
1	8 × 6	10 × 1¼	122½	70·4
1	14 × 6*a*	10 × ⅜	85	70·2
1	12 × 6*b*	10 × ⅝	89	69·6
2	10 × 5	12 × ⅝	113½	68·7
1	15 × 5	9 × ½	75	67·7
2	12 × 5	12 × ⅜	97	66·7
1	12 × 6*a*	10 × ½	90½	66·4
2	8 × 5	12 × ⅞	130	65·6
2	8 × 6	14 × ⅝	132	65·3
1	10 × 5	9 × 1	93½	64·9
1	12 × 5	9 × ¾	80½	63·9
1	10 × 6	10 × ¾	95½	63·6
1	14 × 6*b*	10 × ⅜	74	63·4
3	8 × 5	18 × ⅜	133½	62·1
1	12 × 6*b*	10 × ½	80½	61·4
2	10 × 5	12 × ½	103½	61·1
2	8 × 5	12 × ¾	119½	59·4
1	8 × 6	10 × 1	105½	58·9
1	10 × 5	9 × ⅞	86	58·6
1	15 × 5	9 × ⅜	67½	58·5
1	12 × 6*a*	10 × ⅜	82	58·4
2	8 × 6	14 × ½	120	58·2
1	10 × 6	10 × ⅝	87	56·7
1	12 × 5	9 × ⅝	72½	56·5
2	10 × 5	12 × ⅜	93	53·6

Composed of			Weight per foot in lbs.	Maximum Moment of Resistance in foot tons.
1 2 3	Steel Joist(s).	Plates, each Flange to form.		
2	8 × 5	12 × ⅝	109½	53·3
1	12 × 6*b*	10 × ⅜	72	53·2
1	8 × 6	10 × ⅞	97	53·2
1	10 × 5	9 × ¾	78½	52 3
1	8 × 5	9 × 1	91½	51·2
2	8 × 6	14 × ⅜	108	51·1
1	10 × 6	10 × ½	78½	50·0
1	12 × 5	9 × ½	65	49·1
1	8 × 6	10 × ¾	88½	47·6
2	8 × 5	12 × ½	99½	47·3
1	10 × 5	9 × ⅝	70½	46·1
1	8 × 5	9 × ⅞	83½	46·1
1	10 × 6	10 × ⅜	70	43·2
1	8 × 6	10 × ⅝	80	42·1
1	12 × 5	9 × ⅜	57½	41·7
2	8 × 5	12 × ⅜	89	41·4
1	8 × 5	9 × ¾	76½	41·1
1	10 × 5	9 × ½	63	39·9
1	8 × 6	10 × ½	71½	36·6
1	8 × 5	9 × ⅝	69	36·1
1	10 × 5	9 × ⅜	55½	33·9
1	8 × 6	10 × ⅜	63	31·2
1	8 × 5	9 × ½	61	31·2
1	8 × 5	9 × ⅜	53½	26·3

In this table the single, double, and triple joist-compound girders are brought together and arranged in descending order of strength. The method of selection of a suitable girder for any system of loading is as follows:—

Calculate Maximum Bending Moment in foot tons. See Part IV.

Refer to column headed "Maximum Moment of Resistance, foot tons."

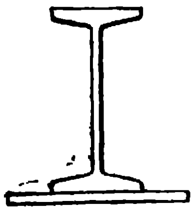
Any girder of which the Maximum Moment of Resistance is not less than the calculated Bending Moment will have sufficient carrying capacity.

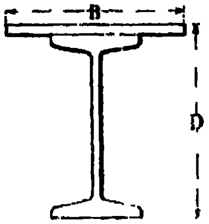
Safe working stress = 7·5 tons per square inch.

Note deflection, web-buckling, and rivet-pitch limitations.

For safe loads and properties of these girders, see pages 20 to 49.

For full explanations of tables, see notes commencing page 108.





COMPOUND GIRDERS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		.6	8	10	12	14	16	18	20	22	24	26	28	30	32
29D	16⅝ × 12	84·6	63·4	50·7	42·3	36·2	31·7	28·2	25·4	23·0	21·1	19·5	18·1	16·9	15·8
28D	16½ × „	82·7	62·0	49·6	41·3	35·4	31·0	27·5	24·8	22·5	20·7	19·1	17·7	16·5	15·5
27D	15⅝ × 12	77·6	58·2	46·6	38·8	33·3	29·1	25·9	23·3	21·2	19·4	17·9	16·6	15·5	14·5
26D	15½ × „	75·9	56·9	45·5	37·9	32·5	28·5	25·3	22·8	20·7	19·0	17·5	16·3	15·2	14·2
25D	15⅝ × 10	54·1	40·5	32·4	27·0	23·2	20·3	18·0	16·2	14·7	13·5	12·5	11·6	10·8	10·1
24D	15½ × „	52·8	39·6	31·7	26·4	22·6	19·8	17·6	15·8	14·4	13·2	12·2	11·3	10·6	9·9
23D	15⅜ × „	51·3	38·5	30·8	25·6	22·0	19·2	17·1	15·4	14·0	12·8	11·8	11·0	10·3	9·6
22D	14⅝ × 12	70·6	52·9	42·3	35·3	30·2	26·5	23·5	21·2	19·2	17·6	16·3	15·1	14·1	13·2
21D	14½ × „	68·5	51·4	41·1	34·2	29·3	25·7	22·8	20·5	18·7	17·1	15·8	14·7	13·7	12·8
20D	14⅝ × 12	58·7	44·1	35·2	29·4	25·1	22·0	19·6	17·6	16·0	14·7	13·6	12·6	11·7	11·0
19D	14½ × „	57·6	43·2	34·5	28·8	24·7	21·6	19·2	17·3	15·7	14·4	13·3	12·3	11·5	10·8
18D	12⅝ × 12	58·1	43·6	34·9	29·1	24·9	21·8	19·4	17·4	15·8	14·5	13·4	12·5	11·6	10·9
17D	12½ × „	57·0	42·7	34·2	28·5	24·4	21·4	19·0	17·1	15·5	14·2	13·1	12·2	11·4	10·7
16D	12⅝ × 12	49·1	36·8	29·4	24·5	21·0	18·4	16·4	14·7	13·4	12·3	11·3	10·5	9·8	9·2
15D	12½ × „	48·0	36·0	28·8	24·0	20·6	18·0	16·0	14·4	13·1	12·0	11·1	10·3	9·6	9·0
14D	12⅜ × „	46·9	35·2	28·1	23·4	20·1	17·6	15·6	14·1	12·8	11·7	10·8	10·0	9·4	8·8
13D	12⅝ × 10	35·0	26·2	21·0	17·5	15·0	13·1	11·7	10·5	9·5	8·7	8·1	7·5	7·0	6·6
12D	12½ × „	34·2	25·6	20·5	17·1	14·6	12·8	11·4	10·2	9·3	8·5	7·9	7·3	6·8	6·4
11D	12⅜ × „	33·2	24·9	20·0	16·6	14·2	12·5	11·1	10·0	9·0	8·3	7·7	7·1	6·6	6·2
10D	10⅝ × 12	39·7	29·7	23·8	19·8	17·0	14·9	13·2	11·9	10·8	9·9	9·1	8·5	7·9	7·4
9D	10½ × „	38·8	29·1	23·3	19·4	16·6	14·6	12·9	11·6	10·6	9·7	9·0	8·3	7·8	
8D	10⅝ × 10	27·9	20·9	16·7	14·0	12·0	10·5	9·3	8·4	7·6	7·0	6·4	6·0	5·6	5·2
7D	10½ × „	27·2	20·4	16·3	13·6	11·7	10·2	9·1	8·2	7·4	6·8	6·3	5·8	5·4	
6D	10⅜ × „	26·5	19·9	15·9	13·2	11·3	9·9	8·8	7·9	7·2	6·6	6·1	5·7	5·3	
5D	8⅝ × 12	26·7	20·0	16·0	13·3	11·4	10·0	8·9	8·0	7·3	6·7	6·2			
4D	8½ × „	26·1	19·6	15·6	13·0	11·2	9·8	8·7	7·8	7·1	6·5	6·0	Rivets ¾-in. diam. at 6-in. pitch		
3D	8⅝ × 10	21·4	16·1	12·8	10·7	9·2	8·0	7·1	6·4	5·8	5·3	4·9			
2D	8½ × „	20·9	15·7	12·5	10·4	8·9	7·8	7·0	6·3	5·7	5·2	4·8			
1D	8⅜ × „	20·3	15·2	12·2	10·2	8·7	7·6	6·8	6·1	5·5	5·1				

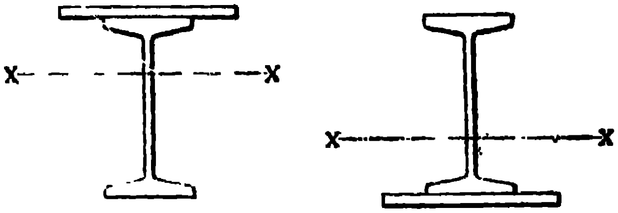
Tabular loads to right of full zigzag line will produce deflection greater than 1/26th of an inch per foot of span.

Girders supporting full tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



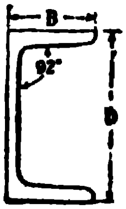
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 Foot Span for		Deflection Coefficient. X—X
One Steel Joist.	One Flange Plate.					Girder.	1 in. Plate width.	
16 × 6	12 × $\frac{5}{8}$	89	25·7	1058	101·5	507	10·4	·000900
"	" × $\frac{1}{2}$	83½	24·2	997	99·2	496	9·6	·000934
15 × 6	12 × $\frac{5}{8}$	86	24·8	918	93·2	466	9·4	·000951
"	" × $\frac{1}{2}$	81	23·3	865	91·1	455	8·7	·000987
15 × 5	10 × $\frac{5}{8}$	64½	18·6	657	64·9	324	8·3	·000926
"	" × $\frac{1}{2}$	60½	17·3	617	63·4	317	7·8	·000964
"	" × $\frac{3}{8}$	56	16·1	572	61·6	308	7·0	·001009
14 × 6*a*	12 × $\frac{5}{8}$	84	24·3	784	84·7	423	8·6	·001012
"	" × $\frac{1}{2}$	79	22·8	740	82·2	411	7·6	·001042
14 × 6*b*	12 × $\frac{5}{8}$	73	21·0	678	70·5	352	7·1	·000974
"	" × $\frac{1}{2}$	68	19·5	638	69·1	345	6·8	·001016
12 × 6*a*	12 × $\frac{5}{8}$	81	23·4	560	69·8	349	7·1	·001168
"	" × $\frac{1}{2}$	76	21·9	527	68·4	342	6·7	·001217
12 × 6*b*	12 × $\frac{5}{8}$	71	20·4	491	58·9	294	5·9	·001126
"	" × $\frac{1}{2}$	66	18·9	461	57·6	288	5·6	·001172
"	" × $\frac{3}{8}$	60½	17·4	428	56·3	281	5·2	·001234
12 × 5	10 × $\frac{5}{8}$	54½	15·7	358	42·0	210	5·2	·001100
"	" × $\frac{1}{2}$	50½	14·4	335	41·0	205	5·1	·001147
"	" × $\frac{3}{8}$	46	13·2	310	39·9	199	4·7	·001207
10 × 6	12 × $\frac{5}{8}$	69	19·9	334	47·6	238	4·9	·001338
"	" × $\frac{1}{2}$	64	18·4	313	46·6	233	4·6	·001395
10 × 5	10 × $\frac{5}{8}$	52½	15·1	241	33·5	167	4·2	·001301
"	" × $\frac{1}{2}$	48½	13·8	225	32·7	163	4·1	·001360
"	" × $\frac{3}{8}$	44	12·6	208	31·8	159	3·8	·001432
8 × 6	12 × $\frac{5}{8}$	62	17·8	186	32·0	160	3·3	·001611
"	" × $\frac{1}{2}$	57	16·3	174	31·3	156	3·2	·001685
8 × 5	10 × $\frac{5}{8}$	50½	14·5	151	25·7	128	3·2	·001600
"	" × $\frac{1}{2}$	46½	13·2	141	25·1	125	3·1	·001672
"	" × $\frac{3}{8}$	42	12·0	129	24·4	122	2·9	·001766

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



STEEL CHANNELS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.														
		4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
BSC27	*15 × 4	62·8	41·9	31·4	25·1	20·9	17·9	15·7	13·9	12·5	11·4	10·5	9·6	9·0	8·4	7·8
BSC26	12 × 4	45·4	30·3	22·7	18·2	15·1	13·0	11·3	10·1	9·1	8·2	7·6	7·0	6·5		
BSC25	*12 × 3½	39·7	26·5	19·9	15·9	13·2	11·3	9·9	8·8	7·9	7·2	6·6	6·1	5·7		
BSC24	*12 × 3½	33·0	22·0	16·5	13·2	11·0	9·4	8·2	7·3	6·6	6·0	5·5	5·1	4·7		
BSC23	11 × 4	38·7	25·8	19·4	15·5	12·9	11·0	9·7	8·6	7·7	7·0	6·4	5·9			
BSC22	11 × 3½	33·8	22·5	16·9	13·5	11·3	9·6	8·4	7·5	6·7	6·1	5·6	5·2			
BSC21	10 × 4	32·7	21·8	16·3	13·1	10·9	9·3	8·1	7·2	6·5	5·9	5·4				
BSC20	*10 × 3½	29·5	19·6	14·7	11·8	9·8	8·4	7·4	6·5	5·9	5·3	4·9				
BSC19	*10 × 3½	25·6	17·1	12·8	10·3	8·5	7·3	6·4	5·7	5·1	4·6	4·3				
BSC18	9 × 4	28·2	18·8	14·1	11·3	9·4	8·0	7·0	6·2	5·6	5·1					
BSC17	*9 × 3½	24·4	16·3	12·2	9·8	8·1	7·0	6·1	5·4	4·9	4·4					
BSC16	*9 × 3½	22·2	14·8	11·1	8·9	7·4	6·3	5·5	4·9	4·4	4·0					
BSC15	9 × 3	18·1	12·0	9·0	7·2	6·0	5·2	4·5	4·0	3·6	3·3					
BSC14	8 × 4	23·1	15·4	11·6	9·2	7·7	6·6	5·8	5·1	4·7						

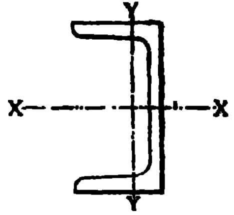
Tabular loads to right of zigzag line will produce deflection greater than 1/26th of an inch per foot of span.

Let δ = deflection in inches, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of channels simply supported.

STEEL CHANNELS.

Dimensions and Properties.



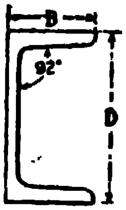
Size. D × B inches.	Weight per foot in lbs.	Area in square inches.	Standard Thicknesses.		Moments of Inertia.		Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span.	Deflection Coefficient. X—X
			Web.	Flange	Maximum. X—X	Minimum. Y—Y			
*15 × 4	41·94	12·334	·525	·630	377·0	14·5	50·2	251·3	·001250
12 × 4	36·47	10·727	·525	·625	218·1	13·6	36·3	181·8	·001562
*12 × 3½	32·88	9·671	·500	·600	190·7	8·9	31·7	158·9	·001562
*12 × 3½	26·10	7·675	·375	·500	158·6	7·5	26·4	132·2	·001562
11 × 4	33·22	9·771	·500	·600	170·4	12·8	30·9	154·9	·001704
11 × 3½	29·82	8·771	·475	·575	148·6	8·4	27·0	135·1	·001704
10 × 4	30·16	8·871	·475	·575	130·7	12·0	26·1	130·7	·001975
*10 × 3½	28·21	8·296	·475	·575	117·9	8·1	23·5	117·9	·001975
*10 × 3½	23·55	6·925	·375	·500	102·6	7·1	20·5	102·6	·001975
9 × 4	28·55	8·396	·475	·575	101·6	11·6	22·5	112·9	·002083
*9 × 3½	25·39	7·469	·450	·550	88·0	7·6	19·5	97·8	·002083
*9 × 3½	22·27	6·550	·375	·500	79·9	6·9	17·7	88·8	·002083
9 × 3	19·37	5·696	·375	·437	65·1	4·0	14·4	72·4	·002083
8 × 4	25·73	7·569	·450	·550	74·0	10·7	18·5	92·5	·002344

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Sections marked (*) are in our stocks.

For full explanation of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



STEEL CHANNELS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.														
		2	3	4	5	6	7	8	9	10	11	12	14	16	18	20
BSC13	*8 × 3½		26·6	19·9	15·9	13·3	11·4	10·0	8·8	8·0	7·2	6·6	5·7	5·0	4·4	4·0
BSC12	8 × 3		22·2	16·7	13·3	11·1	9·5	8·3	7·4	6·7	6·0	5·5	4·8	4·2	3·7	3·3
BSC11	8 × 2½		17·1	12·8	10·3	8·5	7·3	6·4	5·7	5·1	4·6	4·3	3·7	3·2	2·8	2·5
BSC10	*7 × 3½		21·2	15·9	12·7	10·6	9·1	7·9	7·0	6·4	5·8	5·3	4·5	4·0	3·5	
BSC 9	7 × 3		17·9	13·4	10·7	8·9	7·7	6·7	5·9	5·4	4·9	4·5	3·8	3·3	3·0	
BSC 8	6 × 3½		16·5	12·3	9·9	8·2	7·0	6·2	5·5	4·9	4·5	4·1	3·5	3·1		
BSC 7	*6 × 3		14·5	10·8	8·7	7·2	6·2	5·4	4·8	4·3	3·9	3·6	3·1	2·7		
BSC 6	*6 × 3		13·3	10·0	8·0	6·7	5·7	5·0	4·4	4·0	3·6	3·3	2·8	2·5		
BSC 5	6 × 2½	15·6	10·4	7·8	6·3	5·2	4·5	3·9	3·5	3·1	2·8	2·6	2·2	1·9		
BSC 4	*5 × 2½	12·1	8·1	6·1	4·9	4·0	3·5	3·0	2·7	2·4	2·2	2·0				
BSC 3	*4 × 2	7·1	4·8	3·6	2·9	2·4	2·0	1·8	1·6	1·4						
BSC 2	3½ × 2	5·3	3·5	2·6	2·1	1·8	1·5	1·3	1·2							
BSC 1	*3 × 1½	3·3	2·2	1·6	1·3	1·1	0·9	0·8								

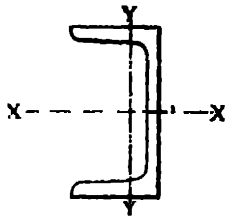
Tabular loads to right of zigzag line will produce deflection greater than 1/26th of an inch per foot of span.

Let δ = deflection in inches, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^2$.

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of channels simply supported.

STEEL CHANNELS.

Dimensions and Properties.



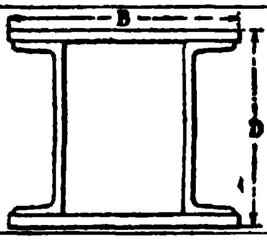
Size, D × B inches.	Weight per foot in lbs.	Area in square inches.	Standard Thicknesses.		Moments of Inertia.		Maximum Modulus of Section. X—X	Safe distributed Load on 1 foot Span.	Deflection Coefficient. X—X
			Web.	Flange	Maximum. X—X	Minimum. Y—Y			
*8 × 3½	22·72	6·682	·425	·525	63·7	7·0	15·9	79·7	·002344
8 × 3	19·30	5·675	·375	·500	53·4	4·3	13·3	66·7	·002344
8 × 2½	15·12	4·448	·312	·437	41·0	2·2	10·2	51·3	·002344
*7 × 3½	20·23	5·950	·400	·500	44·5	6·4	12·7	63·6	·002679
7 × 3	17·56	5·166	·375	·475	37·6	4·0	10·7	53·7	·002679
6 × 3½	17·90	5·266	·375	·475	29·6	5·9	9·8	49·4	·003125
*6 × 3	16·29	4·791	·375	·475	26·0	3·8	8·6	43·4	·003125
*6 × 3	14·49	4·261	·312	·437	24·0	3·5	8·0	40·0	·003125
6 × 2½	12·04	3·542	·312	·375	18·7	1·8	6·2	31·3	·003125
*5 × 2½	10·98	3·230	·312	·375	12·1	1·7	4·8	24·3	·003750
*4 × 2	7·96	2·341	·250	·375	5·7	0·84	2·8	14·3	·004687
3½ × 2	6·75	1·986	·250	·312	3·7	0·71	2·1	10·6	·005357
*3 × 1½	5·27	1·549	·250	·312	1·9	0·29	1·3	6·6	·006251

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Sections marked (*) are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



COMPOUND GIRDERS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		6	8	10	12	14	16	18	20	22	24	26	28	30	32
29E	16½ × 16					*88·3*	*77·2*	*68·6*	*61·8*	*56·2*	*51·5*	47·5	44·1	41·2	38·6
28E	16¼ × "			*110*	*92·2*	*79·0*	*69·1*	*61·5*	55·3	50·3	46·1	42·5	39·5	36·9	34·6
27E	16 × "		*122*	*97·8*	*81·5*	*69·8*	61·1	54·3	48·9	44·4	40·7	37·6	34·9	32·6	30·5
26E	16½ × 12			*101*	*84·1*	*72·1*	*63·1*	56·1	50·5	45·9	42·1	38·8	36·0	33·6	31·5
25E	16¼ × "		*115*	*91·9*	*76·6*	65·6	57·4	51·0	45·9	41·8	38·3	35·3	32·8	30·6	28·7
24E	16 × "	*138*	*103*	*82·8*	69·0	59·1	51·7	46·0	41·4	37·6	34·5	31·8	29·6	27·6	25·9
23E	13½ × 16					*64·9*	*66·8*	*50·5*	*45·4*	*41·3*	*37·9*	*34·9*	32·4	30·3	
22E	13¼ × "				*67·0*	*57·5*	*50·3*	*44·7*	*40·2*	36·6	33·5	30·9	28·7	26·8	
21E	13 × "		*87·6*	*70·1*	*58·4*	*50·1*	43·8	38·9	35·0	31·8	29·2	26·9	25·0	23·3	
20E	13¼ × 12		*81·8*	*65·4*	*54·5*	*46·7*	40·9	36·3	32·7	29·7	27·3	25·2	23·3	21·8	
19E	13 × "	*96·8*	*72·6*	*58·1*	48·4	41·5	36·3	32·3	29·0	26·4	24·2	22·3	20·7	19·3	
18E	11½ × 16					*52·1*	*45·6*	*40·5*	*36·5*	*33·1*	*30·4*	28·0			
17E	11¼ × "				*53·5*	*45·9*	*40·1*	*35·7*	*32·1*	29·2	26·7	24·7			
16E	11 × "		*69·5*	*55·6*	*46·3*	*39·7*	*34·7*	30·9	27·8	25·3	23·1	21·3			
15E	11¼ × 12		*64·6*	*51·7*	*43·1*	*36·9*	32·3	28·7	25·8	23·5	21·5	19·8			
14E	11 × "	*75·9*	*56·9*	*45·5*	37·9	32·5	28·4	25·3	22·8	20·7	18·9	17·5			
13E	10½ × 16					*45·8*	*40·1*	*35·6*	*32·1*	*29·1*	*26·7*				
12E	10¼ × "				*46·9*	*40·2*	*35·2*	*31·3*	*28·1*	25·5	23·4				
11E	10 × "			*48·4*	*40·4*	*34·6*	*30·3*	26·9	24·2	22·0	20·2				
10E	10¼ × 12		*56·2*	*44·9*	*37·4*	*32·1*	28·1	25·0	22·5	20·4	18·7				
9E	10 × "	*65·7*	*49·3*	*39·4*	32·9	28·2	24·6	21·9	19·7	17·9	16·2				
8E	9¼ × 16				*40·6*	*34·8*	*30·4*	*27·0*	*24·3*	22·1					
7E	9 × "			*41·7*	*34·8*	*29·8*	*26·1*	23·2	20·8	18·9					
6E	9¼ × 12		*48·3*	*38·6*	*32·2*	*27·6*	24·1	21·4	19·3	17·5					
5E	9 × "	*56·1*	*42·1*	*33·7*	28·1	24·1	21·0	18·7	16·8	15·3					
4E	8¼ × 16				*34·6*	*29·6*	*25·9*	*23·0*	*20·7*						
3E	8 × "			*35·4*	*29·5*	*25·3*	*22·1*	19·6	17·7						
2E	8¼ × 12		*40·8*	*32·6*	*27·2*	*23·3*	20·4	18·1	16·3						
1E	8 × "	*47·2*	*35·4*	*28·3*	23·6	20·2	17·7	15·7	14·1						

Rivets ¾-in. diameter.

Tabular loads to right of full zigzag line produce deflection greater than 1/26th of an inch per foot of span.

Girders supporting tabular loads to left of dotted zigzag line require stiffeners to prevent web buckling.

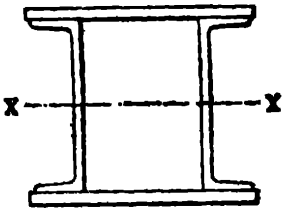
Girders supporting tabular loads printed in ordinary type have rivets at 6 inches pitch.

Girders supporting tabular loads printed in italics require a closer pitch of rivets. See page 59.

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported.

COMPOUND GIRDERS.

Composition and Properties.



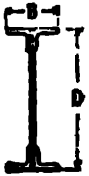
Composed of		Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section. X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Two Steel Channels.	Plates, each Flange to form.					Girder.	1 in. Plate width.	
15 × 4	16 × ¾	168	48·7	2039	**247·2**	1236	56·4	·001136
"	" × ⅝	154½	44·7	1798	**221·3**	1106	47·0	·001151
"	" × ½	141	40·7	1565	**195·6**	978	37·5	·001172
"	12 × ¾	147½	42·7	1667	**202·0**	1010	56·4	·001136
"	" × ⅝	137½	39·7	1493	**183·8**	919	47·0	·001151
"	" × ½	127	36·7	1324	**165·6**	828	37·5	·001172
12 × 3½	16 × ¾	150	43·3	1227	**181·8**	909	45·2	·001389
"	" × ⅝	136½	39·3	1066	**160·9**	804	37·6	·001415
"	" × ½	122½	35·3	912	**140·2**	701	30·0	·001442
"	12 × ⅝	119½	34·3	867	**130·9**	654	37·6	·001415
"	" × ½	109	31·3	755	**116·2**	581	30 0	·001442
10 × 3½	16 × ¾	140½	40·6	839	**145·9**	729	37·7	·001630
"	" × ⅝	127	36·6	723	**128·5**	642	31·4	·001667
"	" × ½	113½	32·6	612	**111·2**	556	25·0	·001704
"	12 × ⅝	110	31·6	582	**103·4**	517	31·4	·001667
"	" × ½	100	28·6	501	**91·1**	455	25·0	·001704
9 × 3½	16 × ¾	135	38·9	674	**128·3**	641	34·0	·001785
"	" × ⅝	121½	34·9	577	**112·6**	563	28·3	·001829
"	" × ½	107½	30·9	485	**96·9**	484	22·6	001875
"	12 × ⅝	104½	29·9	461	**89·9**	449	28·3	·001829
"	" × ½	94	26·9	394	**78·9**	394	22·6	·001875
8 × 3½	16 × ⅝	116	33·4	450	**97·4**	487	25·1	·002027
"	" × ½	102½	29 4	376	**83·5**	417	20·1	·002083
"	12 × ⅝	99	28·4	357	**77·2**	386	25·1	·002027
"	" × ½	88½	25·4	303	**67·4**	337	20·1	·002083
7 × 3½	16 × ⅝	111	31·9	342	**83·0**	415	22·0	·002273
"	" × ½	97½	27·9	283	**70·7**	353	17·6	·002344
"	12 × ⅝	94	26·9	269	**65·3**	326	22·0	·002273
"	" × ½	84	23·9	227	**56·6**	283	17·6	·002344

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then δ = K×L².

For full explanations of tables, see notes commencing on page 108.

For formulæ, explanations of properties, &c., see Part IV.



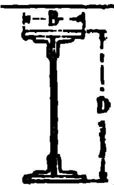


PLATE GIRDERS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		14	16	18	20	22	24	26	28	30	32	34	36	40	44
41 F	40 × 12⅜	145	127	113	102	92·7	85·0	78·4	72·8	68·0	63·7	60·0	56·6	51·0	46·3
40 F	" × 10⅜	122	107	95·0	85·5	77·7	71·3	65·8	61·1	57·0	53·4	50·3	47·5	42·7	38·9
31 F	36 × 12⅜	127	111	98·7	88·9	80·8	74·0	68·4	63·5	59·2	55·5	52·3	49·3	44·4	40·4
30 F	" × 10⅜	106	93·0	82·7	74·4	67·6	62·0	57·2	53·1	49·6	46·5	43·7	41·3	37·2	33·8
21 F	32 × 10⅜	91·1	79·7	70·9	63·8	58·0	53·1	49·1	45·5	42·5	39·9	37·5	35·4	31·9	29·0
20 F	" × 8⅜	80·2	70·2	62·4	56·1	51·0	46·8	43·2	40·1	37·4	35·1	33·0	31·2	28·0	25·5
11 F	28 × 10⅜	76·7	67·1	59·6	53·7	48·8	44·7	41·3	38·3	35·7	33·5	31·5	29·8	26·8	24·4
10 F	" × 8⅜	67·2	58·8	52·3	47·7	42·8	39·2	36·2	33·6	31·4	29·4	27·7	26·1	23·5	21·4
35 G	42 × 12	262	229	204	183	167	153	141	131	122	114	108	102	91·8	83·4
34 G	41¾ × "	244	214	190	171	155	142	131	122	114	107	100	95·0	85·5	77·7
33 G	41½ × "	226	198	176	158	144	132	122	113	105	99·1	93·3	88·1	79·3	72·1
32 G	41¼ × "	208	182	162	146	133	122	112	104	97·4	91·3	85·9	81·1	73·0	66·4
31 G	41 × "	191	167	148	133	121	111	103	95·4	89·0	83·5	78·6	74·2	66·8	60·7
25 G	38 × 12	231	202	180	162	147	135	125	116	108	101	95·3	90·0	81·0	73·6
24 G	37¾ × "	215	188	167	151	137	126	116	108	100	94·2	88·7	83·8	75·4	68·5
23 G	37½ × "	199	174	155	139	127	116	107	99·7	93·0	87·2	82·1	77·5	69·7	63·4
22 G	37¼ × "	183	160	142	128	116	107	98·7	91·7	85·5	80·2	75·5	71·3	64·1	58·3
21 G	37 × "	167	146	130	117	106	97·6	90·1	83·7	78·1	73·2	68·9	65·1	58·6	53·2
15 G	34 × 12	193	169	150	135	123	112	104	96·5	90·1	84·4	79·5	75·1	67·5	61·4
14 G	33¾ × "	178	156	139	125	113	104	96·2	89·3	83·4	78·2	73·6	69·5	62·5	56·8
13 G	33½ × "	164	144	128	115	104	95·9	88·6	82·2	76·7	71·9	67·7	63·9	57·5	52·3
12 G	33¼ × "	150	131	117	105	95·5	87·6	80·8	75·1	70·0	65·7	61·8	58·4	52·5	47·7
11 G	33 × "	136	119	105	95·1	86·5	79·3	73·2	67·9	63·4	59·4	55·9	52·8	47·5	43·2
5 G	30 × 12	165	144	128	115	105	96·3	88·9	82·5	77·0	72·2	68·0	64·2	57·8	52·5
4 G	29¾ × "	152	133	118	107	97·1	89·0	82·1	76·3	71·2	66·7	62·8	59·3	53·4	48·5
3 G	29½ × "	140	122	109	98·1	89·1	81·7	75·4	70·0	65·4	61·3	57·7	54·5	49·0	44·5
2 G	29¼ × "	127	111	99·3	89·3	81·2	74·4	68·7	63·6	59·5	55·8	52·5	49·6	44·6	40·6
1 G	29 × "	115	101	89·6	80·6	73·3	67·2	62·0	57·6	53·7	50·4	47·4	44·8	40·3	36·6

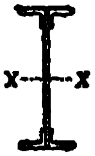
The above safe loads are based on the following assumptions :—

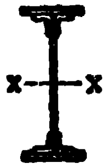
Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported. Requisite rivet pitch adopted. Webs adequately stiffened. Efficient lateral support provided.

Weights per foot are for sections of girders only; they do not include any allowance for stiffeners.

PLATE GIRDERS.

Composition and Properties.





Composed of			Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Web Plate.	Each Flange.						Girder.	1 in. Plate Width.	
	Plate Thickness.	Section of Angles.							
40 × ⅜		6 × 4 × ½	118	34·0	8159	408·0	2040		·000469
"		5 × 3 × ½	104½	30·0	6844	342·2	1711		·000469
36 × ⅜		6 × 4 × ½	113	32·5	6401	355·6	1778		·000521
"		5 × 3 × ½	99½	28·5	5359	297·7	1488		·000521
32 × ⅜		5 × 3 × ½	94½	27·0	4085	255·3	1276		·000586
"		4 × 3 × ½	87½	25·0	3596	224·7	1123		·000586
28 × ⅜		5 × 3 × ½	89	25·5	3007	214·8	1074		·000670
"		4 × 3 × ½	82½	23·5	2636	188·3	941		·000670
40 × ⅜	1	4 × 4 × ½	190½	54·0	15427	734·6	3673	200·1	·000447
"	⅞	"	180½	51·0	14290	684·5	3422	175·1	·000450
"	¾	"	170	48·0	13166	634·5	3172	150·0	·000452
"	⅝	"	160	45·0	12056	584·5	2922	125·0	·000455
"	½	"	150	42·0	10960	534·6	2673	100·0	·000457
36 × ⅜	1	4 × 4 × ½	185½	52·5	12319	648·3	3241	180·1	·000493
"	⅞	"	175½	49·5	11389	603·3	3016	157·6	·000497
"	¾	"	165	46·5	10471	558·3	2791	135·0	·000500
"	⅝	"	155	43·5	9565	513·5	2567	112·5	·000503
"	½	"	145	40·5	8672	468·7	2343	90·0	·000507
32 × ⅜	1	3½ × 3½ × ½	173½	49·0	9191	540·6	2703	160·2	·000552
"	⅞	"	163½	46·0	8447	500·5	2502	140·1	·000556
"	¾	"	153	43·0	7714	460·5	2302	120·1	·000560
"	⅝	"	143	40·0	6991	420·5	2102	100·0	·000564
"	½	"	133	37·0	6280	380·6	1903	80·0	·000568
28 × ⅜	1	3½ × 3½ × ½	168½	47·5	6936	462·4	2312	140·2	·000625
"	⅞	"	158½	44·5	6357	427·3	2136	122·6	·000630
"	¾	"	148	41·5	5789	392·4	1962	105·1	·000636
"	⅝	"	138	38·5	5229	357·5	1787	87·5	·000641
"	½	"	128	35·5	4679	322·7	1613	70·0	·000647

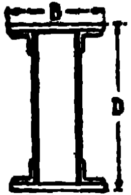
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

When "plate thickness, each flange," exceeds ¾ of an inch, two plates may be used.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.



BOX PLATE GIRDERS.

Safe Distributed Loads, in Tons.

Reference Mark.	Size, D × B inches.	SPANS IN FEET.													
		14	16	18	20	22	24	26	28	30	32	34	36	40	44
37H	42½ × 18	439	384	341	307	279	256	236	219	205	192	180	170	153	139
35H	42 × "	382	334	297	267	243	223	205	191	178	167	157	148	133	121
34H	41¾ × "	354	309	275	247	225	206	190	177	165	155	145	137	124	112
33H	41½ × "	325	285	253	227	207	190	175	162	152	142	134	126	114	103
32H	41¼ × "	297	260	231	208	189	173	160	148	138	130	122	115	104	94·4
31H	41 × "	268	235	209	188	171	156	144	134	125	117	110	104	94·0	85·4
27H	38½ × 18	387	339	301	271	246	226	208	193	180	169	159	150	135	123
25H	38 × "	336	294	261	235	214	196	181	168	157	147	138	130	117	107
24H	37¾ × "	311	272	242	217	197	181	167	155	145	136	128	120	108	98·8
23H	37½ × "	285	249	222	199	181	166	153	142	133	124	117	111	100	90·7
22H	37¼ × "	259	227	202	181	165	151	140	130	121	113	107	101	90·8	82·6
21H	37 × "	234	205	182	163	149	136	126	117	109	102	96·4	91·0	81·9	74·4
17H	34½ × 18	329	288	256	230	209	192	177	164	153	144	135	128	115	104
15H	34 × "	283	248	220	198	180	165	152	141	132	124	116	110	99·1	90·1
14H	33¾ × "	260	228	202	182	165	152	140	130	121	114	107	101	91·1	82·8
13H	33½ × "	238	208	185	166	151	138	128	119	111	104	97·9	92·4	83·2	75·6
12H	33¼ × "	215	188	167	150	137	125	116	107	100	94·1	88·5	83·6	75·2	68·4
11H	33 × "	192	168	149	134	122	112	103	96·2	89·7	84·1	79·2	74·8	67·3	61·2
7H	30½ × 18	281	246	219	197	179	164	151	140	131	123	116	109	98·5	89·5
5H	30 × "	241	211	188	169	153	141	130	121	112	105	99·4	93·9	84·5	76·8
4H	29¾ × "	221	194	172	155	141	129	119	111	103	97·0	91·3	86·2	77·6	70·5
3H	29½ × "	202	176	157	141	128	117	108	101	94·1	88·3	83·1	78·4	70·6	64·2
2H	29¼ × "	182	159	141	127	116	106	97·9	91·0	84·9	79·6	74·9	70·7	63·6	57·9
1H	29 × "	162	142	126	113	103	94·5	87·3	81·0	75·6	70·9	66·7	63·0	56·7	51·5

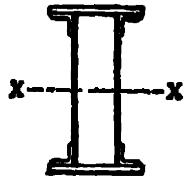
The above safe loads are based on the following assumptions :—

Safe working stress = 7·5 tons per square inch, equal to a factor of safety of 4. Ends of girders simply supported. Requisite rivet pitch adopted. Webs adequately stiffened. Efficient lateral support provided.

Weights per foot are for sections of girders only; they do not include any allowance for stiffeners.

BOX PLATE GIRDERS.

Composition and Properties.



Composed of			Weight per foot in lbs.	Area in square inches.	Maximum Moment of Inertia. X—X	Maximum Modulus of Section X—X	Safe Distributed Load on 1 foot Span for		Deflection Coefficient. X—X
Two Web Plates	Each Flange.						Girder.	1 in. Plate width.	
	Plate Thickness.	Section of Angles.							
40 × ⅜	1¼	4 × 4 × ½	315	90·0	26126	1229·0	6145	250·3	·000441
"	1	"	284½	81·0	22472	1070·0	5350	200·1	·000447
"	⅞	"	269½	76·5	20677	990·5	4952	175·1	·000450
"	¾	"	254	72·0	18904	911·1	4555	150·0	·000452
"	⅝	"	238	67·5	17152	831·6	4158	125·0	·000455
"	½	"	223½	63·0	15421	752·1	3760	100·0	·000458
36 × ⅜	1¼	4 × 4 × ½	305	87·0	20880	1084·0	5420	225·3	·000487
"	1	"	274½	78·0	17885	941·3	4706	180·1	·000494
"	⅞	"	259	73·5	16417	869·9	4349	157·6	·000497
"	¾	"	244	69·0	14968	798·3	3991	135·0	·000500
"	⅝	"	228½	64·5	13539	727·0	3635	112·5	·000504
"	½	"	213	60·0	12128	655·5	3277	90·0	·000507
32 × ⅜	1¼	3½ × 3½ × ½	288	82·0	15884	920·8	4604	200·3	·000544
"	1	"	257½	73·0	13483	793·1	3965	160·2	·000552
"	⅞	"	242	68·5	12309	729·4	3647	140·1	·000556
"	¾	"	227	64·0	11151	665·7	3328	120·1	·000560
"	⅝	"	211½	59·5	10011	602·2	3011	100·0	·000564
"	½	"	196	55·0	8888	538·7	2693	80·0	·000569
28 × ⅜	1¼	3½ × 3½ × ½	278	79·0	12020	788·1	3940	175·4	·000615
"	1	"	247	70·0	10146	676·4	3382	140·2	·000625
"	⅞	"	232	65·5	9233	620·7	3103	122·6	·000631
"	¾	"	216½	61·0	8335	565·0	2825	105·0	·000636
"	⅝	"	201½	56·5	7452	509·5	2547	87·5	·000641
"	½	"	186	52·0	6583	454·0	2270	70·0	·000647

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

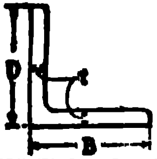
When "plate thickness, each flange," exceeds ¾ of an inch, two plates may be used.

Let δ = deflection, K = deflection coefficient, and L = span in feet, then $\delta = K \times L^3$.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.



STEEL EQUAL ANGLES.

Distributed **BREAKING** Loads,* in Tons.

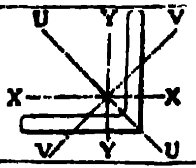
Reference Mark.	Size, D × B × t inches.	SPANS IN FEET.													
		3	4	5	6	7	8	9	10	11	12	13	14	15	16
BSEA 14*g*	6 × 6 × ¾	43·7	32·7	26·2	21·8	18·7	16·4	14·5	13·1	11·9	10·9	10·1	9·3	8·7	8·2
BSEA 14*f*	" × ⅝	36·9	27·7	22·2	18·5	15·8	13·8	12·3	11·1	10·1	9·2	8·5	7·9	7·4	6·9
BSEA 14*e*	" × ½	30·0	22·5	18·0	15·0	12·8	11·2	10·0	9·0	8·1	7·5	6·9	6·4	6·0	5·6
BSEA 13*g*	5 × 5 × ¾	29·6	22·2	17·8	14·8	12·7	11·1	9·8	8·9	8·1	7·4	6·8	6·3	5·9	5·5
BSEA 13*f*	" × ⅝	25·2	18·9	15·1	12·6	10·8	9·4	8·4	7·5	6·8	6·3	5·8	5·4	5·0	4·7
BSEA 13*e*	" × ½	20·5	15·3	12·3	10·2	8·8	7·7	6·8	6·1	5·6	5·1	4·7	4·4	4·1	3·8
BSEA 12*g*	4½ × 4½ × ¾	23·7	17·8	14·2	11·8	10·1	8·9	7·9	7·1	6·4	5·9	5·4	5·0	4·7	4·4
BSEA 12*f*	" × ⅝	20·1	15·1	12·1	10·1	8·6	7·5	6·7	6·0	5·5	5·0	4·6	4·3	4·0	3·7
BSEA 12*e*	" × ½	16·4	12·3	9·8	8·2	7·0	6·1	5·5	4·9	4·5	4·1	3·8	3·5	3·3	3·0
BSEA 11*g*	4 × 4 × ¾	18·4	13·8	11·1	9·2	7·9	6·9	6·1	5·5	5·0	4·6	4·2	3·9	3·7	3·4
BSEA 11*f*	" × ⅝	15·7	11·8	9·4	7·8	6·7	5·9	5·2	4·7	4·3	3·9	3·6	3·3	3·1	2·9
BSEA 11*e*	" × ½	12·8	9·6	7·7	6·4	5·5	4·8	4·3	3·8	3·5	3·2	2·9	2·7	2·5	2·4
BSEA 11*d*	" × ⅜	9·8	7·4	5·9	4·9	4·2	3·7	3·3	2·9	2·7	2·4	2·2	2·1	1·9	1·8
BSEA 10*f*	3½ × 3½ × ⅝	11·8	8·8	7·1	5·9	5·0	4·4	3·9	3·5	3·2	2·9	2·7	2·5	2·3	2·2
BSEA 10*e*	" × ½	9·7	7·3	5·8	4·8	4·1	3·6	3·2	2·9	2·6	2·4	2·2	2·0	1·9	1·8
BSEA 10*d*	" × ⅜	7·4	5·6	4·4	3·7	3·2	2·8	2·5	2·2	2·0	1·8	1·7	1·6	1·5	1·4

NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis XX or YY.

Angles as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For angles as beams over single spans, with ends simply supported, the factor of safety should be 4.

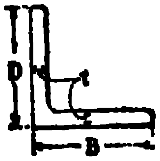
STEEL EQUAL ANGLES.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Moments of Inertia.			Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis XX or Axis YY	Axis UU Max.	Axis VV Min.	Axis XX or Axis YY.	Axis XX or Axis YY.	Axis XX or Axis YY.
6 × 6 × ¾	28·70	8·441	27·79	44·03	11·55	6·55	131·1	·008867
„ × ⅝	24·18	7·113	23·78	37·66	9·90	5·54	110·9	·008748
„ × ½	19·55	5·753	19·52	31·03	8·01	4·50	90·0	·008647
5 × 5 × ¾	23·59	6·938	15·53	24·67	6·39	4·45	89·0	·010748
„ × ⅝	19·92	5·860	13·36	21·09	5·63	3·78	75·5	·010606
„ × ½	16·15	4·751	11·02	17·48	4·56	3·07	61·5	·010464
4½ × 4½ × ¾	21·05	6·189	11·08	17·69	4·47	3·56	71·1	·012047
„ × ⅝	17·80	5·236	9·56	15·16	3·96	3·03	60·5	·011871
„ × ½	14·46	4·252	7·92	12·62	3·22	2·47	49·4	·011697
4 × 4 × ¾	18·49	5·437	7·57	12·01	3·14	2·77	55·3	·013702
„ × ⅝	15·66	4·609	6·56	10·40	2·73	2·36	47·2	·013480
„ × ½	12·75	3·750	5·46	8·70	2·22	1·93	38·6	·013256
„ × ⅜	9·72	2·859	4·26	6·78	1·74	1·48	29·5	·013030
3½ × 3½ × ⅝	13·55	3·985	4·27	6·70	1·84	1·77	35·5	·015580
„ × ½	11·05	3·251	3·57	5·65	1·50	1·46	29·1	·015288
„ × ⅜	8·45	2·485	2·80	4·45	1·15	1·12	22·4	·014994

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.
All above sections are in our stocks.
For full explanations of tables, see notes commencing page 108.
For formulæ, explanations of properties, &c., see Part IV.
Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^3}{F}$



STEEL EQUAL ANGLES.

Distributed BREAKING Loads, in Tons.

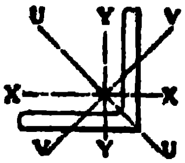
Reference Mark.	Size, D × B × t inches.	SPANS IN FEET.													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
BSEA 9*f*	3 × 3 × $\frac{5}{8}$	12·7	8·5	6·3	5·1	4·2	3·6	3·2	2·8	2·5	2·3	2·1	1·9	1·8	1·7
BSEA 9*e*	" × $\frac{1}{2}$	10·5	7·0	5·2	4·2	3·5	3·0	2·6	2·3	2·1	1·9	1·7	1·6	1·5	1·4
BSEA 9*d*	" × $\frac{3}{8}$	8·1	5·4	4·0	3·2	2·7	2·3	2·0	1·8	1·6	1·4	1·3	1·2	1·1	1·0
BSEA 9*c*	" × $\frac{5}{16}$	6·8	4·5	3·4	2·7	2·2	1·9	1·7	1·5	1·3	1·2	1·1	1·0		
BSEA 9*b*	" × $\frac{1}{4}$	5·5	3·6	2·7	2·2	1·8	1·5	1·3	1·2	1·1	1·0				
BSEA 7*e*	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$	7·0	4·7	3·5	2·8	2·3	2·0	1·7	1·5	1·4	1·2	1·1			
BSEA 7*d*	" × $\frac{3}{8}$	5·4	3·6	2·7	2·2	1·8	1·5	1·3	1·2	1·1					
BSEA 7*c*	" × $\frac{5}{16}$	4·6	3·1	2·3	1·8	1·5	1·3	1·1	1·0	0·9					
BSEA 7*b*	" × $\frac{1}{4}$	3·7	2·5	1·8	1·5	1·2	1·0	0·9	0·8	0·7					
BSEA 6*c*	$2\frac{1}{4} \times 2\frac{1}{4} \times \frac{5}{16}$	3·7	2·5	1·8	1·5	1·2	1·0	0·9	0·8	0·7					
BSEA 6*b*	" × $\frac{1}{4}$	3·0	2·0	1·5	1·2	1·0	0·8	0·7	0·6	0·6					
BSEA 5*b*	2 × 2 × $\frac{1}{4}$	2·3	1·5	1·1	0·9	0·7	0·6	0·6	0·5	0·4					
BSEA 5*a*	" × $\frac{3}{16}$	1·8	1·2	0·9	0·7	0·6	0·5	0·4	0·4	0·3					

NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis XX or YY.

Angles as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For angles as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL EQUAL ANGLES.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Moments of Inertia.			Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis XX or Axis YY.	Axis UU Max.	Axis VV Min.	Axis XX or Axis YY.	Axis XX or Axis YY.	Axis XX or Axis YY.
3 × 3 × ⅝	11·43	3·362	2·59	4·05	1·13	1·27	25·5	·018455
" × ½	9·36	2·753	2·18	3·44	0·92	1·05	21·0	·018063
" × ⅜	7·18	2·112	1·72	2·73	0·71	0·81	16·2	·017664
" × $\frac{5}{16}$	6·05	1·779	1·47	2·34	0·60	0·68	13·7	·017467
" × ¼	4·90	1·440	1·21	1·91	0·50	0·55	11·1	·017258
2½ × 2½ × ½	7·65	2·250	1·20	1·88	0·52	0·71	14·1	·022034
" × ⅜	5·89	1·734	0·96	1·52	0·40	0·55	10·9	·021454
" × $\frac{5}{16}$	4·98	1·464	0·82	1·31	0·33	0·46	9·2	·021175
" × ¼	4·04	1·187	0·68	1·08	0·27	0·37	7·5	·020842
2¼ × 2¼ × $\frac{5}{16}$	4·45	1·310	0·59	0·94	0·24	0·37	7·5	·023690
" × ¼	3·61	1·063	0·49	0·77	0·20	0·30	6·0	·023336
2 × 2 × ¼	3·19	0·938	0·33	0·52	0·14	0·23	4·7	·026428
" × $\frac{3}{16}$	2·43	0·715	0·26	0·41	0·11	0·18	3·6	·025931

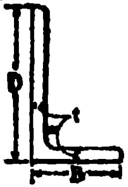
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^3}{F}$



STEEL UNEQUAL ANGLES.

Long Leg Vertical.

Distributed BREAKING Loads, in Tons.

Reference Mark.	Size, D × B × t inches.	SPANS IN FEET. 3	4	5	6	7	8	9	10	11	12	13	14	15	16
BSUA 25*g*	7 × 3½ × ¾	54·0	40·5	32·4	27·0	23·1	20·2	18·0	16·2	14·7	13·5	12·4	11·6	10·8	10·1
BSUA 25*f*	" × ⅝	45·7	34·3	27·4	22·8	19·6	17·1	15·2	13·7	12·4	11·4	10·5	9·8	9·1	8·5
BSUA 25*e*	" × ½	37·2	27·9	22·3	18·6	15·9	13·9	12·4	11·1	10·1	9·3	8·5	7·9	7·4	6·9
BSUA 21*f*	6 × 4 × ⅝	34·8	26·1	20·9	17·4	14·9	13·0	11·6	10·4	9·5	8·7	8·0	7·4	6·9	6·5
BSUA 21*e*	" × ½	28·3	21·2	16·9	14·1	12·1	10·6	9·4	8·5	7·7	7·0	6·5	6·0	5·6	5·3
BSUA 20*f*	6 × 3½ × ⅝	34·1	25·5	20·4	17·0	14·6	12·8	11·3	10·2	9·3	8·5	7·8	7·3	6·8	6·4
BSUA 20*e*	" × ½	27·7	20·8	16·6	13·8	11·8	10·4	9·2	8·3	7·5	6·9	6·4	5·9	5·5	5·2
BSUA 20*d*	" × ⅜	21·0	15·8	12·6	10·5	9·0	7·8	7·0	6·3	5·7	5·2	4·8	4·5	4·2	3·9
RBUA 63*f*	6 × 3 × ⅝	33·1	24·8	19·8	16·5	14·2	12·4	11·0	9·9	9·0	8·2	7·6	7·1	6·6	6·2
RBUA 63*e*	" × ½	27·0	20·2	16·2	13·5	11·5	10·1	9·0	8·1	7·3	6·7	6·2	5·7	5·4	5·0
RBUA 63*d*	" × ⅜	20·6	15·4	12·3	10·3	8·8	7·7	6·8	6·1	5·6	5·1	4·7	4·4	4·1	3·8

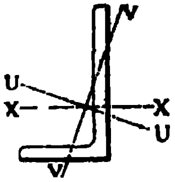
NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis XX.

Angles as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For angles as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL UNEQUAL ANGLES.

Long Leg Vertical.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Moments of Inertia.			Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis XX.	Axis UU Max.	Axis VV Min.	Axis XX.	Axis XX.	Axis XX.
7 × 3½ × ¾	24·86	7·313	35·68	37·73	3·90	8·11	162·2	·008523
" × ⅝	20·98	6·172	30·55	32·32	3·38	6·86	137·2	·008427
" × ½	17·00	5·000	25·10	26·64	2·74	5·58	111·6	·008334
6 × 4 × ⅝	19·92	5·860	20·80	23·83	4·33	5·22	104·4	·009411
" × ½	16·15	4·750	17·13	19·72	3·51	4·24	84·9	·009294
6 × 3½ × ⅝	18·87	5·550	19·89	21·77	3·09	5·11	102·3	·009648
" × ½	15·31	4·502	16·39	18·00	2·53	4·16	83·2	·009525
" × ⅜	11·64	3·424	12·59	13·83	1·98	3·15	63·1	·009399
6 × 3 × ⅝	17·80	5·230	18·79	19·84	2·08	4·97	99·4	·009921
" × ½	14·46	4·252	15·50	16·44	1·68	4·05	81·0	·009792
" × ⅜	11·00	3·236	12·00	12·72	1·33	3·09	61·8	·009665

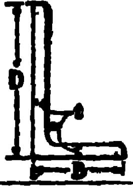
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^2}{F}$



STEEL UNEQUAL ANGLES.

Long Leg Vertical.

Distributed BREAKING Loads, in Tons.

Reference Mark.	Size, D × B × t inches.	SPANS IN FEET.													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
BSUA 17*f*	5 × 4 × ⅝	36·6	24·4	18·3	14·6	12·2	10·4	9·1	8·1	7·3	6·6	6·1	5·6	5·2	4·8
BSUA 17*e*	" × ½	29·9	19·9	14·9	11·9	9·9	8·5	7·4	6·6	5·9	5·4	4·9	4·6	4·2	3·9
BSUA 17*d*	" × ⅜	22·8	15·2	11·4	9·1	7·6	6·5	5·7	5·0	4·5	4·1	3·8	3·5	3·2	3·0
BSUA 15*f*	5 × 3. × ⅝	35·0	23·3	17·5	14·0	11·6	10·0	8·7	7·7	7·0	6·3	5·8	5·3	5·0	4·6
BSUA 15*e*	" × ½	28·6	19·0	14·2	11·4	9·5	8·1	7·1	6·3	5·7	5·2	4·7	4·4	4·0	3·8
BSUA 15*d*	" × ⅜	21·8	14·5	10·9	8·7	7·2	6·2	5·4	4·8	4·3	3·9	3·6	3·3	3·1	2·9
BSUA 11*e*	4 × 3 × ½	18·5	12·3	9·2	7·4	6·1	5·3	4·6	4·1	3·7	3·3	3·1	2·8	2·6	2·4
BSUA 11*d*	" × ⅜	14·2	9·5	7·1	5·7	4·7	4·0	3·5	3·1	2·8	2·6	2·4	2·2	2·0	1·9
BSUA 7*d*	3 × 2½ × ⅜	7·9	5·2	3·9	3·1	2·6	2·2	1·9	1·7	1·5	1·4	1·3	1·2	1·1	1·0
BSUA 7*c*	" × $\frac{5}{16}$	6·6	4·4	3·3	2·6	2·2	1·9	1·6	1·4	1·3	1·2	1·1	1·0	0·9	0·8

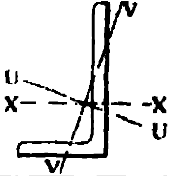
NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis XX.

Angles as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For angles as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL UNEQUAL ANGLES.

Long Leg Vertical.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Moments of Inertia.			Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis XX.	Axis UU Max.	Axis VV Min.	Axis XX.	Axis XX.	Axis XX.
5 × 4 × ⅝	17·80	5·236	12·44	15·84	3·61	3·66	73·2	·011046
" × ½	14·46	4·252	10·29	13·12	3·00	2·99	59·8	·010892
" × ⅜	11·00	3·236	7·96	10·15	2·34	2·28	45·6	·010748
5 × 3 × ⅝	15·67	4·609	11·26	12·38	1·88	3·50	70·0	·016569
" × ½	12·75	3·749	9·33	10·30	1·54	2·86	57·1	·011486
" × ⅜	9·72	2·859	7·24	8·00	1·21	2·18	43·7	·011309
4 × 3 × ½	11·05	3·251	4·98	6·06	1·29	1·85	37·1	·013967
" × ⅜	8·45	2·485	3·89	4·74	1·02	1·42	28·4	·013717
3 × 2½ × ⅜	6·53	1·921	1·62	2·12	0·52	0·79	15·8	·018249
" × 5/16	5·51	1·620	1·39	1·82	0·44	0·67	13·3	·018038

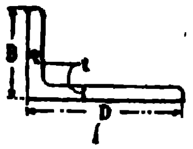
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^3}{F}$



STEEL UNEQUAL ANGLES.

Short Leg Vertical.

Distributed **BREAKING** Loads, in Tons.

Reference Mark.	Size, D × B × t inches.	SPANS IN FEET.													
		3	4	5	6	7	8	9	10	11	12	13	14	15	16
BSUA 25*g*	7 × 3½ × ¾	15·0	11·3	9·0	7·5	6·4	5·6	5·0	4·5	4·1	3·7	3·4	3·2	3·0	2·8
BSUA 25*f*	" × ⅝	12·8	9·6	7·6	6·4	5·5	4·8	4·2	3·8	3·5	3·2	2·9	2·7	2·5	2·4
BSUA 25*e*	" × ½	10·4	7·8	6·2	5·2	4·4	3·9	3·4	3·1	2·8	2·6	2·4	2·2	2·0	1·9
BSUA 21*f*	6 × 4 × ⅝	16·4	12·3	9·8	8·2	7·0	6·1	5·5	4·9	4·5	4·1	3·8	3·5	3·3	3·1
BSUA 21*e*	" × ½	13·4	10·0	8·0	6·7	5·7	5·0	4·6	4·0	3·6	3·3	3·1	2·9	2·7	2·5
BSUA 20*f*	6 × 3½ × ⅝	12·6	9·4	7·5	6·3	5·4	4·7	4·2	3·7	3·4	3·1	2·9	2·7	2·5	2·3
BSUA 20*e*	" × ½	10·3	7·7	6·2	5·1	4·4	3·8	3·4	3·1	2·8	2·5	2·4	2·2	2·0	1·9
BSUA 20*d*	" × ⅜	7·8	5·9	4·7	3·9	3·3	2·9	2·6	2·3	2·1	1·9	1·8	1·6	1·5	1·4
RBUA 63*f*	6 × 3 × ⅝	9·2	6·9	5·5	4·6	3·9	3·4	3·0	2·7	2·5	2·3	2·1	1·9	1·8	1·7
RBUA 63*e*	" × ½	7·5	5·6	4·5	3·7	3·2	2·8	2·5	2·2	2·0	1·8	1·7	1·6	1·5	1·4
RBUA 63*d*	" × ⅜	5·8	4·3	3·4	2·9	2·5	2·1	1·9	1·7	1·5	1·4	1·3	1·2	1·1	1·0

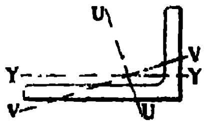
NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis YY.

Angles as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For angles as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL UNEQUAL ANGLES.

Short Leg Vertical.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Moments of Inertia.			Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis YY.	Axis UU Max.	Axis VV Min.	Axis YY.	Axis YY.	Axis YY.
7 × 3½ × ¾	24·86	7·313	5·95	37·73	3·90	2·26	45·2	·003552
" × ⅝	20·98	6·172	5·15	32·32	3·38	1·92	38·4	·003486
" × ½	17·00	5·000	4·28	26·64	2·74	1·56	31·2	·003422
6 × 4 × ⅝	19·92	5·860	7·36	23·83	4·33	2·47	49·4	·003147
" × ½	16·15	4·750	6·10	19·72	3·51	2·02	40·3	·003098
6 × 3½ × ⅝	18·87	5·550	4·97	21·77	3·09	1·89	37·8	·003566
" × ½	15·31	4·502	4·14	18·00	2·53	1·55	31·0	·003502
" × ⅜	11·64	3·424	3·22	13·83	1·98	1·18	23·6	·003438
6 × 3 × ⅝	17·80	5·236	3·13	19·84	2·08	1·38	27·6	·004130
" × ½	14·46	4·252	2·62	16·44	1·68	1·13	22·6	·004041
" × ⅜	11·00	3·236	2·05	12·72	1·33	0·87	17·4	·003956

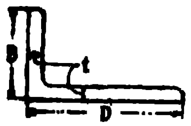
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^3}{F}$



STEEL UNEQUAL ANGLES.

Short Leg Vertical.

Distributed BREAKING Loads, in Tons.

Reference Mark.	Size, D × B × t inches.	SPANS IN FEET.													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
BSUA 17*f*	5 × 4 × ⅝	24·2	16·1	12·1	9·7	8·0	6·9	6·0	5·4	4·8	4·4	4·0	3·7	3·4	3·2
BSUA 17*e*	" × ½	19·8	13·2	9·9	7·9	6·6	5·6	4·9	4·4	3·9	3·6	3·3	3·0	2·8	2·6
BSUA 17*d*	" × ⅜	15·1	10·1	7·5	6·0	5·0	4·3	3·7	3·3	3·0	2·7	2·5	2·3	2·1	2·0
BSUA 15*f*	5 × 3 × ⅝	13·5	9·0	6·7	5·4	4·5	3·8	3·4	3·0	2·7	2·4	2·2	2·1	1·9	1·8
BSUA 15*e*	" × ½	11·1	7·4	5·5	4·4	3·7	3·1	2·7	2·4	2·2	2·0	1·8	1·7	1·6	1·5
BSUA 15*d*	" × ⅜	8·5	5·7	4·2	3·4	2·8	2·4	2·1	1·9	1·7	1·5	1·4	1·3	1·2	1·1
BSUA 11*e*	4 × 3 × ½	10·9	7·2	5·4	4·3	3·6	3·1	2·7	2·4	2·1	1·9	1·8	1·6	1·5	1·4
BSUA 11*d*	" × ⅜	8·3	5·6	4·2	3·3	2·8	2·4	2·1	1·8	1·6	1·5	1·4	1·3	1·2	1·1
BSUA 7*d*	3 × 2½ × ⅜	5·6	3·7	2·8	2·2	1·8	1·6	1·4	1·2	1·1	1·0	0·9	0·8	0·8	0·7
BSUA 7*c*	" × $\frac{5}{16}$	4·7	3·1	2·3	1·9	1·5	1·3	1·1	1·0	0·9	0·8	0·8	0·7	0·7	0·6

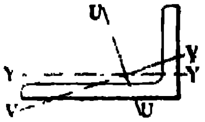
Note particularly that **Breaking** load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis YY.

Angles as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For angles as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL UNEQUAL ANGLES.

Short Leg Vertical.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Moments of Inertia.			Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis YY.	Axis UU Max.	Axis VV Min	Axis YY.	Axis YY.	Axis YY.
5 × 4 × ⅝	17·80	5·236	7·61	15·84	3·61	2·42	48·5	·003242
" × ½	14·46	4·252	5·83	13·12	3·00	1·98	39·6	·003190
" × ⅜	11·00	3·236	4·53	10·15	2·34	1·51	30·3	·003139
5 × 3 × ⅝	15·67	4·609	3·00	12·38	1·88	1·36	27·1	·004239
" × ½	12·75	3·749	2·51	10·30	1·54	1·11	22·2	·004150
" × ⅜	9·72	2·859	1·97	8·00	1·21	0·85	17·1	·004064
4 × 3 × ½	11·05	3·251	2·37	6·06	1·29	1·09	21·7	·004299
" × ⅜	8·45	2·485	1·87	4·74	1·02	0·84	16·7	·004206
3 × 2½ × ⅜	6·53	1·921	1·02	2·12	0·52	0·56	11·2	·005200
" × 5/16	5·51	1·620	0·87	1·82	0·44	0·48	9·5	·005132

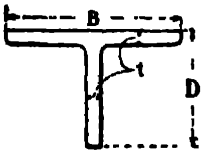
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^2}{F}$



STEEL TEES.

Table Horizontal.

Distributed BREAKING Loads, in Tons.

Reference Mark.	Size, B × D × t inches.	SPANS IN FEET.													
		3	4	5	6	7	8	9	10	11	12	13	14	15	16
BST 21*e*	6 × 4 × ½	13·3	10·0	8·0	6·6	5·7	5·0	4·4	4·0	3·6	3·3	3·0	2·8	2·6	2·5
BST 20*e*	6 × 3 × ½	7·6	5·7	4·5	3·8	3·2	2·8	2·5	2·2	2·0	1·9	1·7	1·6	1·5	1·4
BST 20*d*	" × ⅜	5·8	4·3	3·4	2·9	2·4	2·1	1·9	1·7	1·5	1·4	1·3	1·2	1·1	1·0
BST 19*e*	5 × 4 × ½	13·0	9·8	7·8	6·5	5·6	4·9	4·3	3·9	3·5	3·2	3·0	2·8	2·6	2·4
BST 19*d*	" × ⅜	9·9	7·4	5·9	4·9	4·2	3·7	3·3	2·9	2·7	2·4	2·3	2·1	1·9	1·8
BST 17*e*	5 × 3 × ½	7·4	5·5	4·4	3·7	3·1	2·7	2·4	2·2	2·0	1·8	1·7	1·5	1·4	1·3
BST 17*d*	" × ⅜	5·6	4·2	3·4	2·8	2·4	2·1	1·8	1·7	1·5	1·4	1·3	1·2	1·1	1·0
BST 16*e*	4 × 5 × ½	19·8	14·9	11·9	9·9	8·5	7·4	6·6	5·9	5·4	4·9	4·5	4·2	3·9	3·7
BST 16*d*	" × ⅜	14·6	11·0	8·8	7·3	6·2	5·5	4·8	4·4	4·0	3·6	3·3	3·1	2·9	2·7

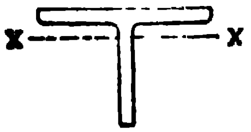
NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis XX.

Tees as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For tees as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL TEES.

Table• Horizontal.

Dimensions and Properties.



Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Moment of Inertia.	Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis XX.	Axis XX.	Axis XX.	Axis XX.
6 × 4 × ½	16·22	4·771	6·07	2·00	40·0	·012377
6 × 3 × ½	14·53	4·272	2·63	1·14	22·8	·016164
,, × ⅜	11·08	3·260	2·06	0·87	17·4	·015823
5 × 4 × ½	14·51	4·268	5·77	1·96	39·2	·012712
,, × ⅜	11·07	3·257	4·47	1·49	29·8	·012500
5 × 3 × ½	12·79	3·762	2·52	1·11	22·2	·016593
,, × ⅜	9·78	2·875	1·97	0·85	17·0	·016234
4 × 5 × ½	14·50	4·264	10·34	2·98	59·6	·010807
,, × ⅜	11·06	3·253	7·77	2·20	44·0	·010624

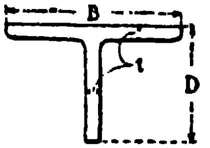
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^2}{F}$



STEEL TEES.

Table Horizontal.

Distributed **BREAKING** Loads, in Tons.

Reference Mark.	Size, B × D × t inches.	SPANS IN FEET.													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
BST 15*e*	4 × 4 × ½	19·0	12·6	9·5	7·6	6·3	5·4	4·7	4·2	3·8	3·4	3·1	2·9	2·7	2·5
BST 15*d*	〃 × ⅜	14·4	9·6	7·2	5·7	4·8	4·1	3·6	3·2	2·8	2·6	2·4	2·2	2·0	1·9
BST 14*e*	4 × 3 × ½	10·8	7·2	5·4	4·3	3·6	3·0	2·7	2·4	2·1	1·9	1·8	1·6	1·5	1·4
BST 14*d*	〃 × ⅜	8·3	5·5	4·1	3·3	2·7	2·3	2·0	1·8	1·6	1·5	1·3	1·2	1·1	1·1
BST 13*e*	3½ × 3½ × ½	14·4	9·6	7·2	5·7	4·8	4·1	3·6	3·2	2·8	2·6	2·4	2·2	2·0	1·9
BST 13*d*	〃 × ⅜	11·0	7·3	5·5	4·4	3·6	3·1	2·7	2·4	2·2	2·0	1·8	1·6	1·5	1·4
BST 11*e*	3 × 3 × ½	10·4	6·9	5·2	4·1	3·4	2·9	2·6	2·3	2·0	1·9	1·7	1·6	1·4	1·3
BST 11*d*	〃 × ⅜	8·0	5·3	4·0	3·2	2·6	2·2	2·0	1·7	1·6	1·4	1·3	1·2	1·1	1·0
BST 8*d*	2½ × 2½ × ⅜	5·5	3·6	2·7	2·2	1·8	1·5	1·3	1·2	1·1	1·0	0·9			
BST 8*b*	〃 × ¼	3·7	2·4	1·8	1·4	1·2	1·0	0·9	0·8	0·7	0·6	0·6			

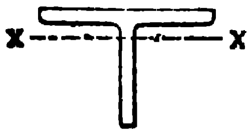
NOTE PARTICULARLY that **BREAKING** load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis XX.

Tees as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For tees as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL TEES.

Tables Horizontal.

Dimensions and Properties.



Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Moment of Inertia.	Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis XX.	Axis XX.	Axis XX.	Axis XX.
4 × 4 × ½	12·78	3·758	5·40	1·90	38·0	·013205
" × ⅜	9·77	2·872	4·19	1·44	28·8	·012976
4 × 3 × ½	11·08	3·260	2·37	1·08	21·6	·017202
" × ⅜	8·49	2·498	1·86	0·83	16·6	·016817
3½ × 3½ × ½	11·08	3·258	3·54	1·44	28·8	·015244
" × ⅜	8·49	2·496	2·77	1·10	22·0	·014941
3 × 3 × ½	9·38	2·760	2·17	1·04	20·8	·018029
" × ⅜	7·21	2·121	1·71	0·80	16·0	·017606
2½ × 2½ × ⅜	5·92	1·741	0·96	0·55	11·0	·021429
" × ¼	4·07	1·197	0·68	0·37	7·4	·020834

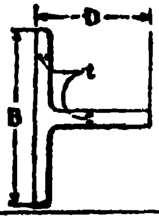
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanation of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^2}{F}$



STEEL TEES.

Stalk Horizontal.

Distributed BREAKING Loads, in Tons.

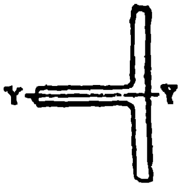
Reference Mark.	Size, B × D × t inches.	SPANS IN FEET.													
		3	4	5	6	7	8	9	10	11	12	13	14	15	16
BST 21*e*	6 × 4 × ½	19·1	14·3	11·4	9·5	8·2	7·1	6·3	5·7	5·2	4·7	4·4	4·1	3·8	3·5
BST 20*e*	6 × 3 × ½	19·2	14·4	11·5	9·6	8·2	7·2	6·4	5·7	5·2	4·8	4·4	4·1	3·8	3·6
BST 20*d*	″ × ⅝	14·2	10·6	8·5	7·1	6·1	5·3	4·7	4·2	3·8	3·5	3·2	3·0	2·8	2·6
BST 19*e*	5 × 4 × ½	13·4	10·0	8·0	6·7	5·7	5·0	4·4	4·0	3·6	3·3	3·1	2·8	2·6	2·5
BST 19*d*	″ × ⅝	9·8	7·4	5·9	4·9	4·2	3·7	3·3	2·9	2·7	2·4	2·2	2·1	1·9	1·8
BST 17*e*	5 × 3 × ½	13·4	10·0	8·0	6·7	5·7	5·0	4·4	4·0	3·6	3·3	3·1	2·8	2·6	2·5
BST 17*d*	″ × ⅝	9·9	7·4	5·9	4·9	4·2	3·7	3·3	2·9	2·7	2·4	2·3	2·1	1·9	1·8
BST 16*e*	4 × 5 × ½	8·6	6·4	5·1	4·3	3·6	3·2	2·8	2·5	2·3	2·1	1·9	1·8	1·7	1·6
BST 16*d*	″ × ⅝	6·2	4·7	3·7	3·1	2·6	2·3	2·0	1·8	1·7	1·5	1·4	1·3	1·2	1·1

NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis YY.

Tees as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For tees as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL TEES.

Stalk Horizontal.



Dimensions and Properties.

Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Moment of Inertia.	Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis YY.	Axis YY.	Axis YY.	Axis YY.
6 × 4 × ½	16·22	4·771	8·62	2·87	57·4	·003125
6 × 3 × ½	14·53	4·272	8·65	2·88	57·6	·003125
„ × ⅜	11·08	3·260	6·39	2·13	42·6	·003125
5 × 4 × ½	14·51	4·268	5·02	2·01	40·2	·003750
„ × ⅜	11·07	3·257	3·69	1·48	29·6	·003750
5 × 3 × ½	12·79	3·762	5·03	2·01	40·2	·003750
„ × ⅜	9·78	2·875	3·72	1·49	29·8	·003750
4 × 5 × ½	14·50	4·264	2·58	1·29	25·8	·004688
„ × ⅜	11·06	3·253	1·89	0·94	18·8	·004688

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of safety, then $\delta = \frac{K \times L^2}{F}$

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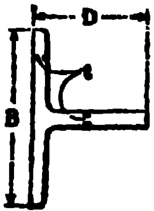


STEEL TEES.

Stalk Horizontal.

Distributed **BREAKING** Loads, in Tons.

Reference Mark.	Size, B × D × t inches.	SPANS IN FEET.													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
BST 15*e*	4 × 4 × ½	12·9	8·6	6·4	5·1	4·3	3·6	3·2	2·8	2·5	2·3	2·1	1·9	1·8	1·7
BST 15*d*	" × ⅜	9·5	6·3	4·7	3·8	3·1	2·7	2·3	2·1	1·9	1·7	1·5	1·4	1·3	1·2
BST 14*e*	4 × 3 × ½	13·0	8·6	6·5	5·2	4·3	3·7	3·2	2·8	2·6	2·3	2·1	2·0	1·8	1·7
BST 14*d*	" × ⅜	9·6	6·4	4·8	3·8	3·2	2·7	2·4	2·1	1·9	1·7	1·6	1·4	1·3	1·2
BST 13*e*	3½ × 3½ × ½	10·0	6·6	5·0	4·0	3·3	2·8	2·5	2·2	2·0	1·7	1·6	1·5	1·4	1·3
BST 13*d*	" × ⅜	7·3	4·8	3·6	2·9	2·4	2·0	1·8	1·6	1·4	1·3	1·2	1·1	1·0	0·9
BST 11*e*	3 × 3 × ½	7·4	4·9	3·7	2·9	2·4	2·1	1·8	1·6	1·4	1·3	1·2	1·1	1·0	0·9
BST 11*d*	" × ⅜	5·4	3·6	2·7	2·1	1·8	1·5	1·3	1·2	1·0	0·9	0·9	0·8	0·7	0·7
BST 8*d*	2½ × 2½ × ⅜	3·8	2·5	1·9	1·5	1·2	1·0	0·9	0·8	0·7	0·7	0·6			
BST 8*b*	" × ¼	2·4	1·6	1·2	0·9	0·8	0·6	0·6	0·5	0·5	0·4	0·4			

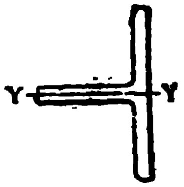
NOTE PARTICULARLY that BREAKING load values are given in this table, based on an ultimate stress of 30 tons per square inch, and corresponding to axis YY.

Tees as purlins or side framing bars (usually bolted at each end and continuous over two or more spans) may be stressed safely up to 10 tons per square inch, equal to a factor of safety of 3. For tees as beams over single spans, with ends simply supported, the factor of safety should be 4.

STEEL TEES.

Stalk Horizontal.

Dimensions and Properties.



Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Moment of Inertia.	Modulus of Section.	Distributed Breaking Load on 1-ft. Span.	Deflection Coefficient.
			Axis YY.	Axis YY.	Axis YY.	Axis YY.
4 × 4 × ½	12·78	3·758	2·59	1·29	25·8	·004688
" × ⅜	9·77	2·872	1·90	0·95	19·0	·004688
4 × 3 × ½	11·08	3·260	2·60	1·30	26·0	·004688
" × ⅜	8·49	2·498	1·91	0·96	19·2	·004688
3½ × 3½ × ½	11·08	3·258	1·75	1·00	20·0	·005357
" × ⅜	8·49	2·496	1·28	0·73	14·6	·005357
3 × 3 × ½	9·38	2·760	1·12	0·74	14·8	·006250
" × ⅜	7·21	2·121	0·82	0·54	10·8	·006250
2½ × 2½ × ⅜	5·92	1·741	0·47	0·38	7·6	·007500
" × ¼	4·07	1·197	0·30	0·24	4·8	·007500

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

All above sections are in our stocks.

For full explanations of tables, see notes commencing page 108.

For formulæ, explanations of properties, &c., see Part IV.

Let δ = deflection in inches, K = deflection coefficient, L = span in feet, and F = factor of afety, then $\delta = \frac{K \times L^2}{F}$

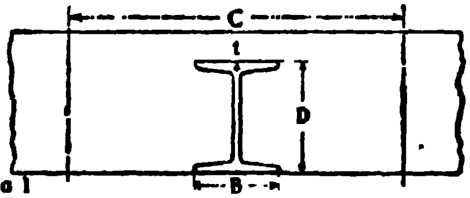


FIG 1

STEEL JOISTS.

Embedded in Concrete.

Safe Distributed Loads, in Tons.

Steel Joist.		Concrete thickness "t" in ins.	SPANS IN FEET.											
Size, D × B inches.	Weight per foot in lbs.		6			7			8			9		
			CONCRETE WIDTH "C" IN INCHES.											
			24	18	12	24	18	12	24	18	12	24	18	12
10 × 5	30	2	33·9	31·3	29·1	29·0	26·8	24·9	25·4	23·4	21·8	22·6	20·8	19·4
		1	32·3	30·3	28·3	27·7	26·0	24·2	24·2	22·7	21·2	21·5	20·2	18·9
		0	30·7	29·1	27·5	26·3	24·9	23·6	23·0	21·8	20·6	20·5	19·4	18·3
9 × 4	21	2	23·3	21·2	19·1	19·9	18·2	16·4	17·4	15·9	14·3	15·5	14·1	12·7
		1	21·7	20·0	18·4	18·6	17·1	15·7	16·2	15·0	13·8	14·5	13·4	12·2
		0	20·2	18·9	17·6	17·3	16·2	15·1	15·2	14·2	13·2	13·5	12·6	11·7
8 × 6	35	2	29·8	28·2	26·4	25·6	24·1	22·7	22·4	21·1	19·8	19·9	18·8	17·6
		1	28·6	27·2	25·8	24·5	23·3	22·1	21·4	20·4	19·4	19·0	18·1	17·2
		0	27·3	26·2	25·2	23·4	22·5	21·5	20·5	19·7	18·8	18·2	17·5	16·7
8 × 5	28	2	25·5	23·8	22·1	21·9	20·4	18·9	19·1	17·8	16·5	17·0	15·8	14·7
		1	24·2	22·8	21·4	20·7	19·5	18·3	18·1	17·1	16·1	16·1	15·2	14·3
		0	22·9	21·8	20·7	19·6	18·7	17·8	17·2	16·4	15·6	15·2	14·5	13·8
8 × 4	18	2	18·4	16·7	15·0	15·8	14·3	12·9	13·8	12·5	11·2	12·2	11·2	10·0
		1	17·1	15·7	14·3	14·6	13·4	12·3	12·8	11·8	10·7	11·4	10·4	9·5
		0	15·7	14·7	13·6	13·5	12·6	11·7	11·8	11·0	10·1	10·5	9·8	9·1
7 × 4	16	2	15·0	13·6	12·2	12·9	11·7	10·5	11·3	10·2	9·1	10·0	9·1	8·1
		1	13·8	12·7	11·6	11·9	10·9	9·9	10·4	9·5	8·7	9·2	8·5	7·7
		0	12·6	11·8	11·0	10·8	10·1	9·4	9·5	8·8	8·2	8·4	7·8	7·3

The above safe distributed loads are for steel and concrete combined, and include the weights of both materials.

Maximum safe working stress for steel in tension = 7·5 tons per square inch.

Maximum safe working stress for concrete in compression = 500 lbs. per square inch.

No allowance is made for concrete in tension.

Safe distributed loads for intermediate values of "t" or "C" may be ascertained by interpolation.

STEEL JOISTS.

Embedded in Concrete.

Safe Distributed Loads, in Tons.

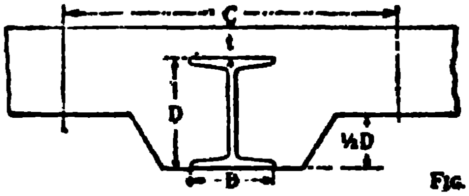


FIG. 2

SPANS IN FEET.

CONCRETE WIDTH "C" IN INCHES.

10			11			12			13			14		
24	18	12	24	18	12	24	18	12	24	18	12	24	18	12
20·3	18·7	17·5	18·5	17·0	15·9	17·0	15·6	14·5	15·6	14·4	13·4	14·5	13·4	12·5
19·4	18·2	17·0	17·6	16·5	15·4	16·1	15·1	14·1	14·9	14·0	13·0	13·8	13·0	12·1
18·4	17·5	16·5	16·7	15·9	15·0	15·4	14·5	13·7	14·2	13·4	12·7	13·2	12·5	11·8
14·0	12·7	11·5	12·7	11·6	10·4	11·6	10·6	9·6	10·7	9·8	8·8	10·0	9·1	8·2
13·0	12·0	11·0	11·9	10·9	10·0	10·9	10·0	9·2	10·0	9·3	8·5	9·3	8·6	7·9
12·1	11·4	10·6	11·0	10·3	9·6	10·1	9·5	8·8	9·3	8·7	8·1	8·7	8·1	7·5
17·9	16·9	15·9	16·3	15·4	14·4	14·9	14·1	13·2	13·8	13·0	12·2	12·8	12·1	11·3
17·1	16·3	15·5	15·6	14·8	14·1	14·3	13·6	12·9	13·2	12·5	11·9	12·2	11·6	11·0
16·4	15·7	15·1	14·9	14·3	13·7	13·6	13·1	12·5	12·6	12·1	11·6	11·7	11·2	10·8
15·3	14·3	13·2	13·9	13·0	12·0	12·7	11·9	11·0	11·8	11·0	10·2	10·9	10·2	9·5
14·5	13·7	12·8	13·2	12·4	11·7	12·1	11·4	10·7	11·2	10·5	9·9	10·4	9·8	9·2
13·7	13·1	12·4	12·5	11·9	11·3	11·4	10·9	10·4	10·6	10·1	9·6	9·8	9·3	8·9
11·1	10·0	9·0	10·1	9·0	8·2	9·2	8·4	7·5	8·5	7·7	6·9	7·9	7·2	6·4
10·2	9·4	8·6	9·3	8·5	7·8	8·5	7·8	7·2	7·9	7·2	6·6	7·3	6·7	6·1
9·4	8·8	8·2	8·6	8·0	7·4	7·9	7·3	6·8	7·3	6·8	6·3	6·7	6·3	5·8
9·0	8·2	7·3	8·2	7·4	6·6	7·5	6·8	6·1	6·9	6·3	5·6	6·4	5·8	5·2
8·3	7·6	6·9	7·5	6·9	6·3	6·9	6·3	5·8	6·4	5·9	5·3	5·9	5·4	5·0
7·6	7·1	6·6	6·9	6·4	6·0	6·3	5·9	5·5	5·8	5·4	5·1	5·4	5·0	4·7

In floor construction the total thickness of the concrete between steel joists may be reduced by the value of ¼D as indicated in Fig. 2, D being the total depth of steel joist.

This does not affect the tabular safe loads, as in the calculation of these the strength of concrete in tension is neglected, and the neutral axis of the combined beam is always above that of the steel joist.

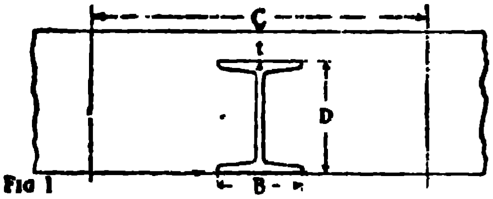


Fig 1

STEEL JOISTS.

Embedded in Concrete.

Safe Distributed Loads, in Tons.

Steel Joist. Size, D × B inches.	Steel Joist. Weight per foot in lbs.	Concrete thickness "t" in ins.	SPANS IN FEET. 6			7			8			9		
			CONCRETE WIDTH "C" IN INCHES.											
			18	15	12	18	15	12	18	15	12	18	15	12
7 × 2¼	12	2	9·6	8·9	8·1	8·3	7·6	6·9	7·2	6·6	6·1	6·4	5·9	5·4
		1	8·7	8·1	7·5	7·4	6·9	6·4	6·5	6·0	5·6	5·8	5·4	5·0
		0	7·7	7·3	6·8	6·6	6·2	5·8	5·8	5·4	5·1	5·2	4·8	4·6
6 × 5	25	2	15·3	14·7	14·2	13·2	12·7	12·2	11·5	11·1	10·7	10·2	9·8	9·5
		1	14·6	14·2	13·8	12·5	12·1	11·8	10·9	10·6	10·3	9·7	9·4	9·2
		0	13·9	13·6	13·3	11·9	11·6	11·4	10·4	10·2	10·0	9·3	9·0	8·8
6 × 4½	20	2	12·8	12·2	11·7	11·0	10·5	10·1	9·6	9·2	8·8	8·5	8·1	7·8
		1	12·1	11·6	11·2	10·3	9·9	9·6	9·0	8·7	8·4	8·0	7·7	7·5
		0	11·3	11·0	10·7	9·7	9·4	9·2	8·5	8·3	8·1	7·5	7·3	7·2
6 × 3	12	2	8·9	8·4	7·8	7·6	7·2	6·7	6·7	6·3	5·9	5·9	5·6	5·2
		1	8·1	7·7	7·3	7·0	6·6	6·2	6·1	5·8	5·5	5·4	5·1	4·9
		0	7·3	7·0	6·8	6·3	6·0	5·8	5·5	5·3	5·1	4·9	4·7	4·5
5½ × 2	9½	2	6·7	6·0	5·4	5·7	5·2	4·6	5·0	4·5	4·0	4·4	4·0	3·6
		1	5·8	5·3	4·8	5·0	4·6	4·2	4·4	4·0	3·6	3·9	3·6	3·2
		0	5·0	4·7	4·3	4·3	4·0	3·7	3·8	3·5	3·2	3·3	3·1	2·9
5 × 4½	18	2	10·2	9·7	9·3	8·7	8·3	8·0	7·6	7·3	7·0	6·8	6·5	6·2
		1	9·5	9·2	8·9	8·2	7·9	7·6	7·2	6·9	6·7	6·4	6·1	5·9
		0	8·9	8·6	8·4	7·6	7·4	7·2	6·7	6·5	6·3	5·9	5·7	5·5

The above safe distributed loads are for steel and concrete combined, and include the weights of both materials.

Maximum safe working stress for steel in tension = 7·5 tons per square inch.

Maximum safe working stress for concrete in compression = 500 lbs. per square inch.

No allowance is made for concrete in tension.

Safe distributed loads for intermediate values of "t" or "C" may be ascertained by interpolation.

STEEL JOISTS.

Embedded in Concrete.

Safe Distributed Loads, in Tons.

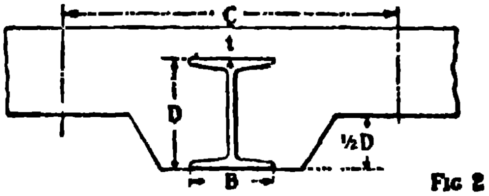


Fig 2

SPANS IN FEET.

CONCRETE WIDTH "C" IN Inches.

10			11			12			13			14		
18	15	12	18	15	12	18	15	12	18	15	12	18	15	12
5·8	5·3	4·9	5·3	4·8	4·4	4·8	4·4	4·1	4·5	4·1	3·7	4·1	3·8	3·5
5·2	4·8	4·5	4·7	4·4	4·1	4·3	4·0	3·7	4·0	3·7	3·4	3·7	3·5	3·2
4·6	4·4	4·1	4·2	4·0	3·7	3·9	3·6	3·4	3·6	3·2	3·2	3·3	3·1	2·9
9·2	8·9	8·6	8·4	8·1	7·8	7·7	7·4	7·1	7·1	6·8	6·6	6·6	6·3	6·1
8·8	8·5	8·3	8·0	7·7	7·5	7·3	7·1	6·9	6·7	6·5	6·4	6·3	6·1	5·9
8·3	8·1	8·0	7·6	7·4	7·2	6·9	6·7	6·6	6·4	6·2	6·1	6·0	5·8	5·7
7·7	7·3	7·0	7·0	6·7	6·4	6·4	6·1	5·9	5·9	5·6	5·4	5·5	5·2	5·0
7·2	6·9	6·7	6·6	6·3	6·1	6·0	5·8	5·6	5·6	5·4	5·2	5·2	5·0	4·8
6·8	6·6	6·4	6·2	6·0	5·9	5·7	5·5	5·4	5·2	5·1	5·0	4·9	4·7	4·6
5·4	5·0	4·7	4·9	4·6	4·3	4·5	4·2	3·9	4·1	3·9	3·6	3·8	3·6	3·3
4·9	4·6	4·4	4·4	4·2	4·0	4·1	3·8	3·6	3·7	3·6	3·4	3·5	3·3	3·1
4·4	4·2	4·1	4·0	3·8	3·7	3·7	3·5	3·4	3·4	3·2	3·1	3·1	3·0	2·9
4·0	3·6	3·2	3·6	3·3	2·9	3·3	3·0	2·7	3·1	2·8	2·5	2·8	2·6	2·3
3·5	3·2	2·9	3·2	2·9	2·6	2·9	2·7	2·4	2·7	2·5	2·2	2·5	2·3	2·1
3·0	2·8	2·6	2·7	2·5	2·3	2·5	2·3	2·1	2·3	2·1	2·0	2·1	2·0	1·8
6·1	5·8	5·6	5·6	5·3	5·1	5·1	4·9	4·7	4·7	4·5	4·3	4·4	4·2	4·0
5·7	5·5	5·3	5·2	5·0	4·8	4·8	4·6	4·4	4·4	4·2	4·1	4·1	3·9	3·8
5·3	5·2	5·1	4·9	4·7	4·6	4·4	4·3	4·2	4·1	4·0	3·9	3·8	3·7	3·6

In floor construction the total thickness of the concrete between steel joists may be reduced by the value of ½D as indicated in Fig. 2, D being the total depth of the steel joist.

This does not affect the tabular safe loads, as in the calculation of these the strength of concrete in tension is neglected, and the neutral axis of the combined beam is always above that of the steel joist.

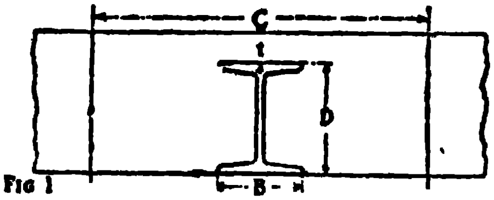


FIG 1

STEEL JOISTS.

Embedded in Concrete.

Safe Distributed Loads, in Tons.

Steel Joist.		Concrete thickness "t" in ins.	SPANS IN FEET.											
			5			6			7			8		
			CONCRETE WIDTH "C" IN INCHES.											
Size, D × B inches.	Weight per foot in lbs.		18	15	12	18	15	12	18	15	12	18	15	12
5 × 3	11	2	8·6	8·1	7·5	7·2	6·7	6·3	6·1	5·8	5·4	5·4	5·0	4·7
		1	7·8	7·4	7·0	6·5	6·1	5·8	5·5	5·3	5·0	4·9	4·6	4·4
		0	6·9	6·7	6·4	5·8	5·6	5·4	5·0	4·8	4·6	4·3	4·2	4·0
4¾ × 1¾	6½	2	5·9	5·4	4·9	4·9	4·5	4·0	4·2	3·8	3·5	3·7	3·4	3·0
		1	5·0	4·6	4·3	4·2	3·9	3·6	3·6	3·3	3·1	3·1	2·9	2·7
		0	4·1	3·9	3·7	3·4	3·3	3·1	2·9	2·8	2·6	2·6	2·4	2·3
4 × 3	9½	2	6·1	5·7	5·3	5·1	4·7	4·4	4·3	4·1	3·8	3·8	3·6	3·3
		1	5·4	5·1	4·9	4·5	4·3	4·0	3·9	3·7	3·5	3·4	3·2	3·0
		0	4·7	4·6	4·4	3·9	3·8	3·7	3·4	3·3	3·1	3·0	2·9	2·8
4 × 1¾	5	2	4·3	3·9	3·5	3·6	3·2	2·9	3·1	2·8	2·5	2·7	2·4	2·2
		1	3·5	3·2	2·9	2·9	2·7	2·4	2·5	2·3	2·1	2·2	2·0	1·8
		0	2·7	2·6	2·4	2·3	2·1	2·0	1·9	1·8	1·7	1·7	1·6	1·5
3 × 3	8½	2	4·1	3·9	3·6	3·5	3·2	3·0	3·0	2·8	2·6	2·6	2·4	2·2
		1	3·6	3·4	3·3	3·0	2·9	2·7	2·6	2·5	2·3	2·3	2·1	2·0
		0	3·1	3·0	2·9	2·6	2·5	2·4	2·2	2·1	2·1	2·0	1·9	1·8
3 × 1½	4	2	2·9	2·6	2·3	2·4	2·2	1·9	2·1	1·9	1·6	1·8	1·6	1·4
		1	2·2	2·0	1·9	1·9	1·7	1·5	1·6	1·5	1·3	1·4	1·3	1·1
		0	1·6	1·5	1·4	1·3	1·2	1·2	1·1	1·1	1·0	1·0	0·9	0·9

The above safe distributed loads are for steel and concrete combined, and include the weights of both materials.

Maximum safe working stress for steel in tension = 7·5 tons per square inch.

Maximum safe working stress for concrete in compression = 500 lbs. per square inch.

No allowance is made for concrete in tension.

Safe distributed loads for intermediate values of "t" and "C" may be ascertained by interpolation.

STEEL JOISTS.

Embedded in Concrete.

Safe Distributed Loads, in Tons.

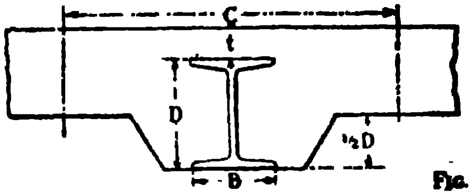
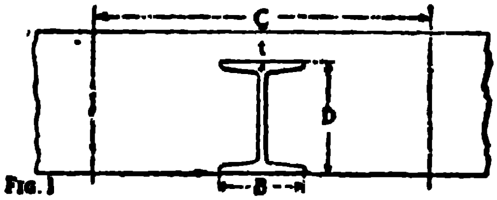


Fig. 2

SPANS IN FEET.														
9			10			11			12			14		
CONCRETE WIDTH "C" IN INCHES.														
18	15	12	18	15	12	18	15	12	18	15	12	18	15	12
4·8	4·5	4·2	4·3	4·0	3·8	3·9	3·7	3·4	3·6	3·4	3·1	3·1	2·9	2·7
4·3	4·1	3·9	3·9	3·7	3·5	3·5	3·3	3·2	3·2	3·1	2·9	2·8	2·6	2·5
3·9	3·7	3·6	3·5	3·3	3·2	3·2	3·0	2·9	2·9	2·8	2·7	2·5	2·4	2·3
3·3	3·0	2·7	2·9	2·7	2·4	2·7	2·4	2·2	2·4	2·2	2·0	2·1	1·9	1·7
2·8	2·6	2·4	2·5	2·3	2·1	2·3	2·1	1·9	2·1	1·9	1·8	1·8	1·7	1·5
2·3	2·2	2·1	2·1	2·0	1·8	1·9	1·8	1·7	1·7	1·6	1·5	1·5	1·4	1·3
3·4	3·2	2·9	3·0	2·8	2·7	2·8	2·6	2·4	2·5	2·4	2·2	2·2	2·0	1·9
3·0	2·8	2·7	2·7	2·6	2·4	2·5	2·3	2·2	2·2	2·1	2·0	1·9	1·8	1·7
2·6	2·5	2·4	2·4	2·3	2·2	2·2	2·1	2·0	2·0	1·9	1·8	1·7	1·6	1·6
2·4	2·1	1·9	2·1	1·9	1·7	1·9	1·8	1·6	1·8	1·6	1·4	1·5	1·4	1·2
1·9	1·8	1·6	1·7	1·6	1·5	1·6	1·5	1·3	1·4	1·3	1·2	1·2	1·1	1·0
1·5	1·4	1·3	1·3	1·3	1·2	1·2	1·2	1·1	1·1	1·1	1·0	1·0	0·9	0·8
2·3	2·1	2·0	2·1	1·9	1·8	1·9	1·8	1·6	1·7	1·6	1·5	1·5	1·4	1·3
2·0	1·9	1·8	1·8	1·7	1·6	1·7	1·6	1·5	1·5	1·4	1·3	1·3	1·2	1·1
1·7	1·7	1·6	1·5	1·5	1·4	1·4	1·4	1·3	1·3	1·2	1·2	1·1	1·0	1·0
1·6	1·4	1·3	1·4	1·3	1·1	1·3	1·2	1·0	1·2	1·1	0·9	1·0	0·9	0·8
1·2	1·1	1·0	1·1	1·0	0·9	1·0	0·9	0·8	0·9	0·8	0·7	0·8	0·7	0·6
0·9	0·8	0·8	0·8	0·7	0·7	0·7	0·7	0·6	0·7	0·6	0·6	0·6	0·5	0·5

In floor construction the total thickness of the concrete between steel joists may be reduced by the value of ½D as indicated in Fig. 2, D being the total depth of the steel joist.

This does not affect the tabular safe loads, as in the calculation of these the strength of concrete in tension is neglected, and the neutral axis of the combined beam is always above that of the steel joist.



STEEL JOISTS.

Embedded in Concrete.

Values of "p" and "q" see page 107 for application.

Steel Joist.		Strength Increases per cent.		Steel Joist.		Strength Increases per cent.	
Size, D × B inches.	Weight per foot in lbs.	Per inch width of concrete =p.	For 1-in. width per inch depth of concrete above flange=q.	Size, D × B inches.	Weight per foot in lbs.	Per inch width of concrete =p.	For 1-in. width per inch depth of concrete above flange=q.
10 × 5	30	1·1075	0·2743	6 × 3	12	1·6719	0·7912
9 × 4	21	1·4521	0·4178	5½ × 2	9½	4·1938	1·5830
8 × 6	35	0·7681	0·2327	5 × 4½	18	0·9865	0·4781
8 × 5	28	0·9538	0·2939	5 × 3	11	1·5457	0·8414
8 × 4	18	1·4846	0·4867	4¾ × 1¾	6½	2·5338	1·7050
7 × 4	16	1·4717	0·5428	4 × 3	9½	1·4478	0·9093
7 × 2¼	12	2·8930	1·0475	4 × 1¾	5	2·7226	2·3988
6 × 5	25	0·8103	0·3383	3 × 3	8½	1·3020	1·1476
6 × 4½	20	0·9878	0·4315	3 × 1½	4	2·5375	3·2781

STEEL JOISTS.

Embedded in Concrete.

Application of "p" and "q" values on page 106, and example for Tables on pages 100 to 105.

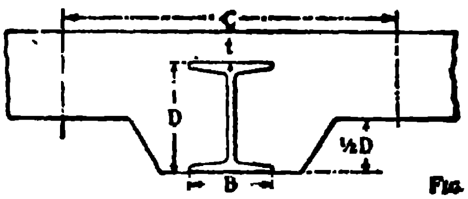


Fig. 2

Safe loads on combined steel and concrete beams for any width or depth of concrete over flange, not given on pages 100 to 105, may be calculated by the percentage values on page 106 opposite.

FORMULA:

C = total width of concrete, in inches, assumed as acting with steel joist.
t = total depth of concrete, in inches, above top flange of steel joist.
p = strength increase per cent. per inch width of concrete, from page 106.
q = strength increase per cent. for 1-in. width of concrete per inch depth of concrete above top flange of steel joist, from page 106.
Ws = tabular safe load in tons for required span in feet for steel joist only, from pages 16 to 19.
W = safe distributed load in tons on combined steel and concrete beam for same span.

$$W = Ws + \frac{Ws\,(p \times C + q \times C \times t)}{100}$$

EXAMPLE:

An 8-in. × 4-in. steel joist will support a safe distributed load of 5·8 tons on a clear span of 12 feet. See table, page 18. Required the safe distributed load in tons on the same span for same section if combined with concrete 17 inches wide and 2½ inches thick over top flange.

$C = 17$ in.; $t = 2\frac{1}{2}$ in.; $p = 1{\cdot}4846$, and $q = 0{\cdot}4867$ from page 106. $Ws = 5{\cdot}8$ tons from page 18.

$$\begin{aligned} W &= 5{\cdot}8 + \frac{5{\cdot}8\,(1{\cdot}4846 \times 17 + 0{\cdot}4867 \times 17 \times 2{\cdot}5)}{100} \\ &= 5{\cdot}8 + 2{\cdot}663 \\ &= 8{\cdot}463 \text{ tons.} \end{aligned}$$

= total safe distributed load, in tons, for combined beam on clear span of 12 feet.

Example of the use of Tables, pages 100 to 105 inclusive.

Required the safe distributed load in tons over 9 feet span for a 6-in. × 3-in. steel joist combined with 15 inches width of concrete, and 1 inch thickness over top flange.

See page 102. Read answer 5·1 tons in column "t" = 1 inch for this section, and below span = 9 feet, and "C" = 15 inches.

PART I.

Explanations of the Tables.

Pages 16 to 107 inclusive.

See Part IV. for general formulæ for the flexure of beams, explanations of properties, &c.

Part I.

Arrangement.

All the tables in this part relate to simple or compound sections, as Beams or Girders.

Steel Joists and Compound Girders formed of these with plates on each flange are the subjects of the tables at the commencement of this part, these being the sections most commonly used.

They are followed by the tables relating to Steel Joists plated on one flange only, Steel Channels, Channel Compound Girders, Plate Girders, Angles and Tees, &c.

Compound Girders.

Pages 20 to 49.

The selection of Compound Girders is very comprehensive, and the practical limitations due to web buckling, deflection or rivet pitch are clearly indicated by zigzag lines or *italics*.

The usefulness of this large range of Compound Girders is increased by the tables of "Rivet Pitches" and "Moments of Resistance," pages 50 to 67 inclusive.

Rivet Pitch.

Pages 50 to 59.

Unless specified otherwise, Compound Girders are riveted at 6 inches pitch. On pages 20 to 49, and page 74, certain loads are printed in *italics*, indicating that the standard pitch of 6 inches is inadequate. For such cases reference should be made to the "Rivet Pitch" tables, pages 50 to 59, from which the required pitch can be readily ascertained.

Moments of Resistance. Pages 60 to 67.

On pages 60 to 67, the single, double, and triple beam types of Compound Girders are collected and arranged in descending order of carrying capacity, the criterion being the value of the "Maximum Moment of Resistance" of the section in foot tons. For equilibrium this value must equal the "Maximum Bending Moment" in foot tons, therefore when the latter quantity has been calculated for any regular or irregular system of loading, the various types of girders suitable either with regard to economy or overall dimensions can be seen at once on reference being made to corresponding values in the columns of "Maximum Moments of Resistance, Foot Tons." The weights per foot of girders of equal strength vary considerably, and it may be noted that where the depth of a section is not restricted, one having a "Moment of Resistance" appreciably in excess of the "Bending Moment" may be found more economical.

Example:—A system of loading produces a maximum bending moment of 283 foot tons. What is the lightest section of girder suitable?

See page 61. The nearest corresponding maximum moment of resistance is 283·8 foot tons for a girder of 369½ lbs. per foot and 15 inches depth. Reading up the same columns, the moments of resistance increase, but lighter weights per foot may be observed for sections of greater depth, the minimum of 206 lbs. being found opposite a resistance moment of 321·2 foot tons, the girder being 26½ inches deep.

Before deciding finally on any particular section, the tables of safe loads, pages 20 to 49, should be referred to in order to see that the deflection, web buckling, and rivet pitch limitations are complied with.

Special Compound Girders. Pages 68 and 69. The Compound Girders formed of Steel Joists, plated on one flange only, are useful when for any special purpose it is desirable to have a broad top flange and a narrow bottom flange, or *vice versâ*.

Pages 74 and 75. The Compound Girders formed of two Steel Channels plated on each flange are used chiefly as lintel beams to support walls, relatively broad, but of no great height or weight.

Plate Girders. Pages 76 to 79. When Plate Girders are used in building work, they, as a rule, are the subject of special calculations. The selection of Plate Girders on pages 76 to 79 will probably be found sufficient to cover the few cases where greater depth is required than can be got by using Steel Joists plated on each flange.

Steel Joists in Concrete. Pages 100 to 107. If Steel Joists are embedded in concrete, as in floors, they are stiffened considerably, and their strength is increased proportionately. The stiffening effect of various widths and thicknesses of concrete is allowed for in the safe distributed loads tabulated on pages 100 to 105. On page 106 there are given percentage increase values per inch width and thickness of concrete, by means of which the safe load for any combination of Joist and concrete may be readily calculated. The application of the tables will be found on page 107.

Tabular Loads. Each tabular load includes the weight of the section or girder itself, and implies uniform distribution over the entire length of the effective span. In building work the "span in feet" is usually taken as the length between

Tabular Loads.

supports, but the calculations are based on the "effective span," *i.e.*, the distance between centres of bearings.

It is assumed that each section or girder has its ends simply supported, not fixed, and is efficiently stayed *laterally* at distances not exceeding 30 times the compression flange width.

Safe Loads.
Pages 16 to 49 and 68 to 79.

Safe loads uniformly distributed are tabulated for each Joist, Channel, Compound and Plate Girder. These are based on a safe working stress of 7·5 tons per square inch at the extreme fibres, corresponding to a factor of safety of 4, taking the mean ultimate tensile strength of the steel at 30 tons per square inch.

Breaking Loads.
Pages 80 to 99.

Breaking loads uniformly distributed are tabulated for each Equal and Unequal Angle and Tee. These are based on an ultimate stress of 30 tons per square inch at the extreme fibres. It is necessary, therefore, in every case that the tabular *breaking* loads be reduced to safe loads by the use of a suitable factor of safety. The *breaking* load of an angle or tee is a more useful value than the safe load based on 7·5 tons per square inch, as the conditions of their use frequently permit of the adoption of a considerably higher stress.

Special Conditions.

The methods of adapting the tables to meet conditions differing from those on which the calculations are based are explained in Part IV.

Dimensions and Properties.

All dimensions of sections are stated in inches, and all properties in inch units.

D = depth, B = breadth, and t = thickness.

Composition of Girders.

The composition of Compound Girders is described in the first two columns of the right-hand pages of the tables. The first column shows the number of Sections used, the second column gives the overall width and total thickness of the plates on each flange. When the latter exceeds ¾ of an inch, plates of convenient thicknesses are used to make up the total required. For instance, a total thickness of 1½ inches may be formed of two ¾ inch or three ½ inch plates.

The composition of Plate Girders is described in the first three columns of the right-hand pages of the tables. The first column gives the overall depth and thickness of the web or webs, the second column the overall width and total thickness of the plates on each flange, and the third column the section and thickness of the angles.

Weights per Foot.

The weights per foot in lbs. include an allowance for rivet heads at the respective pitches of 6 inches for Compound Girders and 4 inches for Plate Girders. The weights of stiffeners, end angles, &c., require to be added.

Areas.

Each area in square inches is the superficial area of a cross section at right angles to the longitudinal axis. No deduction is made for rivet holes in the areas of Compound or Plate Girders, this being allowed for in the calculation of "Moments of Inertia," which see.

Standard Thicknesses.

These standard thicknesses, pages 17, 19, 71, and 73, are those recommended by the Engineering Standards Committee. It may be noted that the mean flange thicknesses given in these tables are approximately equal to the flange thicknesses of the beams at rivet holes in Compound Girders.

Moments of Inertia.

Maximum and minimum moments of inertia are tabulated for each Joist, Channel, and Tee; the maximum moment only for each Compound and Plate Girder.

For each Joist, Channel, Compound and Plate Girder, the maximum moment of inertia is about "Axis X—X" passing through the centre of gravity of the figure and parallel to the flanges. The minimum moment of inertia for these sections is about "Axis Y—Y" passing through the centre of gravity of the figure and parallel to the web or webs. The tabulated safe loads are relative to the maximum moment of inertia, about "Axis X—X."

The tabulated moments of inertia of each Tee are also about central axes, but the maximum moment may be about "Axis X—X" parallel to the table or "Axis Y—Y" parallel to the stalk, depending upon the dimensions of the section. *Breaking* loads are given relative to both moments, maximum and minimum.

For each Angle, four moments of inertia are given about axes passing through the centre of gravity of the figure. These are the maximum and minimum moments about the minor "Axis U—U" and major "Axis V—V" of the inertia ellipse, also the moments about the Axes "X—X" and "Y—Y" parallel to the legs. In the case of equal angles the moments about axes "X—X" and "Y—Y" parallel to the legs are identical. The tabulated *breaking* loads are *not* relative to the maximum and minimum moments, but to the moments about axes "X—X" and "Y—Y." This implies that either leg of the section is at right angles to the direction of the loading.

The moments of inertia of Compound and Plate

Girders are calculated on the net sectional area of the figure, a deduction for rivet holes being made.

Moduli of Sections.

For each Joist, Channel, Compound and Plate Girder, the maximum modulus of section "Axis X—X" corresponding to the maximum moment of inertia is given. These values are printed in prominent type, as they are referred to frequently.

For each Angle and Tee, two section moduli are given. These correspond to the moments of inertia, having the same axial reference letters, thus, "Axis X—X" or "Axis Y—Y."

Loads on 1 foot Span.

The safe distributed load on 1 foot span is tabulated for each section and also for 1 inch width of flange plates. The load on any span is equal to the load on 1 foot span divided by the required span in feet.

The values "for 1 inch plate width" are the variations of the safe distributed loads, in tons, on 1 foot span, for each inch increase or decrease in the width of flange plates. Corresponding section modulus variations may be got by dividing the safe load variations by 5.

These values are convenient for calculating the strength of girders varying slightly in flange plate width from the sections for which complete properties and safe loads are given. They are to be added or subtracted as width is increased or decreased.

Example :—Required safe distributed load in tons over 28 feet span, also section modulus for compound girder 280A, 25 × 12, page 20, with 14 inch instead of 12 inch flange plates.

Loads on 1 foot Span.

Safe load on 1 foot span for girder, - = 1623 tons.
Variation for 1 inch plate width =
60 tons ∴ for two inches, - - - = 120 „

Total safe load on 1 foot span, - - = 1743 „
Safe load on 28 feet span, - $= \frac{1743}{28} = 62{\cdot}2$ „
Section modulus for 2 inches variation of plate width, - $= \frac{120}{5} = 24$ inches.^{3}
Section modulus of girder with 14 inch flange plates, $= \frac{1743}{5} = 348{\cdot}6$ „

Before varying the tabulated sections of girders inquiries should be made to ascertain if the desired new widths of flange plates are obtainable, as otherwise inconvenience and delay may follow.

Dotted Zigzag Lines.

The dotted zigzag lines indicate the limiting loads for shear or web buckling. They are placed to the immediate left of the minimum spans over which the sections can support the *full tabular loads* without provision being made to stiffen the webs. If sections are used over shorter spans:—(1) web stiffeners must be provided, suitable forms of which are shown in Part V., or (2) the maximum loads must not exceed the tabular loads to the immediate right of the lines.

Dotted zigzag lines are not inserted in the Plate Girder tables, it being assumed that girders of these types will require web stiffeners in accordance with usual practice. The design and spacing of these stiffeners will depend on

Dotted Zigzag Lines. the depth and thickness of the webs and the system of loading.

Full Zigzag Lines. The full zigzag lines are placed to the immediate right of the maximum spans over which the sections can support the full tabular loads without the deflection exceeding 1/26th of an inch per foot of span. For a symmetrical section, this limit corresponds to 24 times its depth in inches, and for an unsymmetrical section to 48 times the distance in inches from the neutral axis to the extreme fibre.

If sections are intended to support plastered ceilings, it is advisable that the deflection should not exceed 1/32nd of an inch per foot of span. This limit will be complied with if the maximum span for the full tabular load corresponds to 20 times the depth in inches of a symmetrical section, and to 40 times the distance in inches from the neutral axis to the extreme fibre of an unsymmetrical section.

The distances in inches from the neutral axis to the extreme fibre of unsymmetrical sections will be found in Part V.

Deflection Coefficients. A deflection co-efficient, derived from the general deflection formula for uniformly distributed loading, is given for each section.

The formula for its use is as follows:—

$$\left.\begin{array}{l}\delta = \text{deflection in inches,}\\ K = \text{deflection coefficient,}\\ L = \text{span in feet,}\end{array}\right\}\delta = K \times L^2.$$

Deflection in inches = deflection coefficient × the square of the span in feet.

Deflection Coefficients.

This simplified deflection formula is only applicable under the conditions for which the safe uniformly distributed loads in the tables are calculated, viz.:—

That the modulus of elasticity of the steel is 12,000 tons (average) per square inch.

That the ends of the section are simply supported, not fixed.

That the full tabular load is carried.

Pages 80 to 99.

As uniformly distributed breaking loads are given for Angles and Tees, the formula for the use of the deflection coefficient is modified by the insertion of a factor of safety as follows:—

δ = deflection in inches,
K = deflection coefficient,
L = span in feet,
F = factor of safety,

$$\delta = \frac{K \times L^2}{F}$$

Deflection in inches = deflection coefficient × the square of the span in feet and ÷ the factor of safety.

Suitable factors of safety are indicated on the tables.

The methods of adapting the deflection coefficients to meet special conditions of loading and limited allowable deflection are explained in Part IV.

PART II.

STANCHIONS.

SAFE LOADS

(BY MONCRIEFF FORMULAE)

AND

PROPERTIES,

Etc.

CONTENTS OF PART II.

PAGE

Steel Joists as Stanchions, - - - - - - - - 122

Compound Steel Stanchions—

Single Joist Type, - - - - - - - - 126

Two Joists Latticed, - - - - - - 136

Double Joist Type, - - - - - - - - 140

Steel Channels as Stanchions, - - - - - - - 150

Compound Steel Stanchions—

Two Channels Latticed, - - - - - - - 154

Double Channel Type, - - - - - - - - 156

Steel Angles as Stanchions, - - - - - - - 160

Compound Steel Stanchions or Struts—

Two Equal Angles Back to Back, - - - - - 168

Two Unequal " " " - - - - 172

Two Equal Angles Battened, - - - - - - 180

Steel Tees as Stanchions, - - - - - - - - 184

Solid Round Steel Columns, - - - - - - - - 188

Explanations of Tables, - - - - - - - - 192

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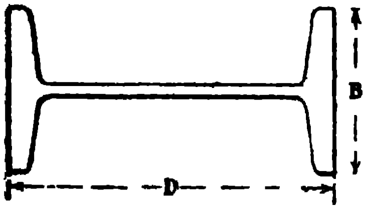


STANCHIONS.

Steel Joists.

Safe Concentric Loads, in Tons.
Ends Flat.

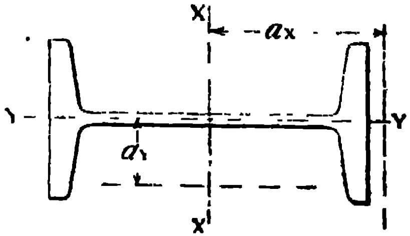
Reference Mark.	Size, D × B inches	HEIGHTS IN FEET													
		8	9	10	11	12	13	14	15	16	17	18	20	22	24
30 J	24 × 7½	182	179	175	170	165	160	145	126	111	98 3	87·7	71·0		
29 J	20 × 7½	163	160	156	152	148	144	136	118	104	92 1	82·2	66 5		
28 J	18 × 7	136	133	130	126	122	117	101	88 0	77·3	68 5	61·1			
27 J	16 × 6	108	105	101	95 2	79 9	68 1	58 7	51·1	45 0					
26 J	15 × 6	104	101	98 0	94 3	83 2	70·9	61 2	53·3	46 8	41·5				
25 J	15 × 5	68 8	62 6	50 7	41 9	35 2	30·0								
24 J	14 × 6*a*	101	98·3	95 1	91 6	82 5	70 3	60 6	52 8	46·4	41 1				
23 J	14 × 6*b*	81 3	78 9	76 2	73 3	63 7	54 3	46 8	40·8	35 8					
22 J	12 × 6*a*	96 5	93 9	91 1	88 0	83 4	71·1	61·3	53 4	46·9	41 5				
21 J	12 × 6*b*	78 4	76 2	73 8	71 2	65 7	56 0	48 3	42 0	36·9	32 7				
20 J	12 × 5	53 1	50 6	41 4	34 2	28 8	24 5								
19 J	10 × 8	131	129	127	125	123	121	118	115	112	105	93·9	76·1	62 9	52 8
18 J	10 × 6	75 4	73·5	71·4	69 0	66 5	57·7	49·7	43·3	38·1	33·7	30·1			
17 J	10 × 5	50 4	48·1	41 6	34·4	28·9	24 6	21·2							
16 J	9 × 7	107	105	103	101	98·8	96·2	93 4	87 5	76·9	68 1	60 7	49 2		

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.
For other conditions and formulæ, see notes commencing page 192.
For explanations of properties, &c., see Part IV.

STANCHIONS.

Steel Joists.

Dimensions and Properties.



Size, D×B inches.	Weight per foot in lbs.	Area in square inches.	Standard Thicknesses.		Radii of Gyration.		Eccentricity Coefficients.			
			Web.	Flange.	Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
24 × 7½	100	29·392	·600	1·070	**1·51**	9·50	**1·50**	2·60	**$1+1{\cdot}65a_Y$**	$1+0{\cdot}13a_X$
20 × 7½	89	26·164	·600	1·010	**1·54**	7·99	**1·47**	2·57	**$1+1{\cdot}57a_Y$**	$1+0{\cdot}16a_X$
18 × 7	75	22·066	·550	·928	**1·45**	7·22	**1·46**	2·56	**$1+1{\cdot}66a_Y$**	$1+0{\cdot}17a_X$
16 × 6	62	18·227	·550	·847	**1·22**	6·31	**1·56**	2·61	**$1+2{\cdot}02a_Y$**	$1+0{\cdot}20a_X$
15 × 6	59	17·346	·500	·880	**1·27**	6·02	**1·46**	2·55	**$1+1{\cdot}85a_Y$**	$1+0{\cdot}21a_X$
15 × 5	42	12·351	·420	·647	**0·98**	5·89	**1·55**	2·62	**$1+2{\cdot}59a_Y$**	$1+0{\cdot}22a_X$
14 × 6*a*	57	16·769	·500	·873	**1·29**	5·64	**1·45**	2·54	**$1+1{\cdot}80a_Y$**	$1+0{\cdot}22a_X$
14 × 6*b*	46	13·533	·400	·698	**1·26**	5·70	**1·38**	2·51	**$1+1{\cdot}88a_Y$**	$1+0{\cdot}22a_X$
12 × 6*a*	54	15·879	·500	·883	**1·33**	4·86	**1·42**	2·52	**$1+1{\cdot}69a_Y$**	$1+0{\cdot}26a_X$
12 × 6*b*	44	12·946	·400	·717	**1·31**	4·93	**1·35**	2·48	**$1+1{\cdot}75a_Y$**	$1+0{\cdot}25a_X$
12 × 5	32	9·408	·350	·550	**1·02**	4·83	**1·42**	2·54	**$1+2{\cdot}41a_Y$**	$1+0{\cdot}26a_X$
10 × 8	70	20·582	·600	·970	**1·86**	4·09	**1·35**	2·49	**$1+1{\cdot}15a_Y$**	$1+0{\cdot}30a_X$
10 × 6	42	12·358	·400	·736	**1·36**	4·14	**1·33**	2·46	**$1+1{\cdot}62a_Y$**	$1+0{\cdot}29a_X$
10 × 5	30	8·820	·360	·552	**1·05**	4·06	**1·41**	2·52	**$1+2{\cdot}26a_Y$**	$1+0{\cdot}30a_X$
9 × 7	58	17·064	·550	·924	**1·64**	3·67	**1·36**	2·51	**$1+1{\cdot}29a_Y$**	$1+0{\cdot}34a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, etc., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W_e = actual eccentric load; K = relative eccentricity coefficient; W_c = equivalent concentric value; $W_c = W_e \times K$.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

For Stanchions in Buildings of Steel Skeleton Construction in London (see Part VI)

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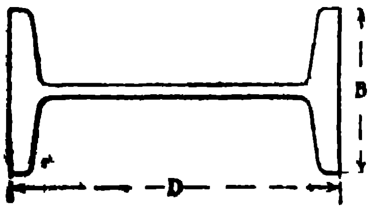


STANCHIONS.

Steel Joists.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark	Size, D × B inches	HEIGHTS IN FEET														
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
15 J	9 × 4	40 0	38 9	37 5	35 8	33 8	27 9	22 0	17 8							
14 J	8 × 6	68 0	67 3	66 4	65 3	64 0	62 4	60 7	58 8	56 8	52 9	45 1	38 9	33 9	29 8	26 4
13 J	8 × 5	54 1	53 4	52 3	51 1	49 6	47 9	46 0	43 5	36 0	30 2	25 8	22 2			
12 J	8 × 4	34 2	33 3	32 1	30 6	28 9	23 7	18 7	15 2							
11 J	7 × 4	30 5	29 7	28 7	27 5	26 1	22 6	17 9	14 5	12 0						
10 J	6 × 5	48 3	47 6	46 7	45 6	44 2	42 7	41 0	38 7	32 0	26 9	22 9	19 7			
9 J	6 × 4½	38 4	37 6	36 6	35 4	34 0	32 4	28 4	23 0	19 0	16 0					
8 J	6 × 3	22 2	21 1	19·6	15 8	11 6	8 9									
7 J	5 × 4½	34 7	34 1	33 3	32 4	31 3	30 0	28 6	24 0	19 9	16 7	14 2				
6 J	5 × 3	20 6	19 7	18 6	17 3	12 7	9 7									
4 J	4 × 3	17 8	17 0	16 1	15 0	11 1	8 5	6 7								
2 J	3 × 3	16 0	15 4	14 6	13 7	10 9	8 4	6 6								
1 J	3 × 1½	5 8	3 3													

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat"

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line

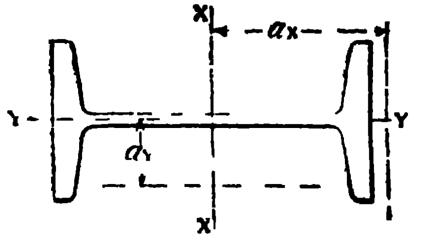
For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c, see Part IV

STANCHIONS.

Steel Joists.

Dimensions and Properties.



Size, D × B inches.	Weight per foot in lbs	Area in square inches	Standard Thicknesses.		Radii of Gyration.		Eccentricity Coefficients.			
			Web	Flange.	Axis Y—Y	Axis X—X	Web.	Flange	Axis Y—Y	Axis X—X
9 × 4	21	6·178	·300	·460	**0·82**	3·62	**1·44**	2·54	**$1 + 2{\cdot}95a_Y$**	$1 + 0{\cdot}34a_x$
8 × 6	35	10·293	·440	597	**1·32**	3·28	**1·38**	2·49	**$1 + 1{\cdot}72a_Y$**	$1 + 0{\cdot}37a_x$
8 × 5	28	8·241	·350	·575	**1·11**	3·29	**1·35**	2·48	**$1 + 2{\cdot}01a_Y$**	$1 + 0{\cdot}37a_x$
8 × 4	18	5·297	280	·402	**0·82**	3·24	**1·42**	2·52	**$1 + 2{\cdot}97a_Y$**	$1 + 0{\cdot}38a_x$
7 × 4	16	4·709	250	·387	**0·85**	2·88	**1·35**	2·47	**$1 + 2{\cdot}76a_Y$**	$1 + 0{\cdot}42a_x$
6 × 5	25	7·354	410	·520	**1·11**	2·43	**1·42**	2·52	**$1 + 2{\cdot}02a_Y$**	$1 + 0{\cdot}51a_Y$
6 × 4½	20	5·882	370	431	**0·96**	2·42	**1·45**	2·53	**$1 + 2{\cdot}45a_Y$**	$1 + 0{\cdot}51a_x$
6 × 3	12	3·527	·260	348	**0·61**	2·39	**1·52**	2·57	**$1 + 3{\cdot}96a_Y$**	$1 + 0{\cdot}53a_x$
5 × 4½	18	5·290	·290	·448	**1·03**	2·07	**1·31**	2·46	**$1 + 2{\cdot}11a_Y$**	$1 + 0{\cdot}58a_x$
5 × 3	11	3·238	·220	·376	**0·67**	2·05	**1·37**	2·49	**$1 + 3{\cdot}32a_Y$**	$1 + 0{\cdot}60a_x$
4 × 3	9½	2·795	220	336	**0·67**	1·64	**1·36**	2·49	**$1 + 3{\cdot}28a_Y$**	$1 + 0{\cdot}74a_x$
3 × 3	8½	2·501	·200	·332	**0·71**	1·23	**1·30**	2·49	**$1 + 2{\cdot}98a_Y$**	$1 + 0{\cdot}99a_x$
3 × 1½	4	1·176	160	·248	**0·32**	1·18	**1·57**	2·60	**$1 + 7{\cdot}10a_Y$**	$1 + 1{\cdot}07a_x$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_x respectively.

For full explanations of tables, see notes commencing page 192.

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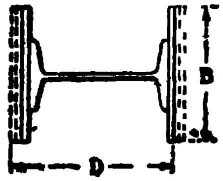


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		10	12	14	16	18	20	22	24	26	28	30	32	36	40
278 K	27 × 14	466	461	455	448	440	432	422	411	400	388	355	312	247	200
276 K	26½ × "	420	415	409	403	395	387	377	367	356	345	302	265	209	169
274 K	26 × "	374	369	363	357	349	341	333	323	313	286	249	219	173	140
273 K	25¾ × "	350	345	340	333	326	318	309	300	290	253	221	194	153	
272 K	25½ × "	327	322	317	310	303	295	286	277	258	222	193	170	134	
271 K	25¼ × "	303	298	293	286	279	271	262	253	222	191	166	146	115	
258 K	23 × 14	446	441	435	429	422	414	405	395	385	374	354	311	245	199
256 K	22½ × "	399	395	390	384	377	369	361	351	342	331	299	263	208	168
254 K	22 × "	353	349	344	338	331	324	316	307	298	282	245	216	170	138
253 K	21¾ × "	330	325	321	315	308	301	293	285	276	251	219	192	152	123
252 K	21½ × "	306	302	297	292	285	278	270	262	253	220	191	168	133	
251 K	21¼ × "	283	279	274	268	262	255	247	239	219	189	164	145	114	
238 K	21 × 12	377	371	365	358	350	340	331	320	301	260	226	199	157	
236 K	20½ × "	337	332	326	319	311	303	294	283	256	220	192	169	133	
234 K	20 × "	297	293	287	280	273	265	256	247	210	181	158	139		
233 K	19¾ × "	278	273	267	261	254	246	237	220	188	162	141	124		
232 K	19½ × "	258	253	248	241	234	226	218	194	165	142	121	109		
231 K	19¼ × "	238	233	228	221	214	207	198	167	142	123	107	94·1		

Rivets ⅞ in diam at 6 in pitch

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

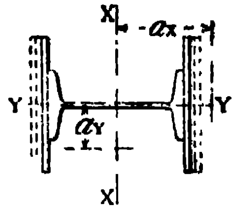
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line

For other conditions and formulæ, see notes commencing page 192

For explanations of properties, &c, see Part IV

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
24 × 7½	14 × 1½	246½	71·4	**3·24**	11·53	**1·20**	2·37	**$1+0{\cdot}67a_Y$**	$1+0{\cdot}10a_X$
"	" × 1¼	223	64·4	**3·15**	11·31	**1·21**	2·37	**$1+0{\cdot}71a_Y$**	$1+0{\cdot}11a_X$
"	" × 1	199	57·4	**3·03**	11·07	**1·23**	2·38	**$1+0{\cdot}76a_Y$**	$1+0{\cdot}11a_X$
"	" × ⅞	187	53·9	**2·94**	10·94	**1·24**	2·39	**$1+0{\cdot}81a_Y$**	$1+0{\cdot}11a_X$
"	" × ¾	175	50·4	**2·85**	10·79	**1·26**	2·40	**$1+0{\cdot}86a_Y$**	$1+0{\cdot}11a_X$
"	" × ⅝	163½	46·9	**2·74**	10·64	**1·28**	2·41	**$1+0{\cdot}93a_Y$**	$1+0{\cdot}11a_X$
20 × 7½	14 × 1½	235½	68·1	**3·31**	9·79	**1·19**	2·38	**$1+0{\cdot}64a_Y$**	$1+0{\cdot}12a_X$
"	" × 1¼	212	61·1	**3·22**	9·59	**1·20**	2·38	**$1+0{\cdot}68a_Y$**	$1+0{\cdot}12a_X$
"	" × 1	188	54·1	**3·10**	9·37	**1·22**	2·38	**$1+0{\cdot}73a_Y$**	$1+0{\cdot}13a_X$
"	" × ⅞	179½	50·6	**3·02**	9·25	**1·23**	2·38	**$1+0{\cdot}77a_Y$**	$1+0{\cdot}13a_X$
"	" × ¾	164	47·1	**2·93**	9·13	**1·25**	2·39	**$1+0{\cdot}82a_Y$**	$1+0{\cdot}13a_X$
"	" × ⅝	152½	43·6	**2·82**	8·99	**1·27**	2·40	**$1+0{\cdot}88a_Y$**	$1+0{\cdot}13a_X$
18 × 7	12 × 1½	201	58·0	**2·87**	8·88	**1·20**	2·40	**$1+0{\cdot}73a_Y$**	$1+0{\cdot}14a_X$
"	" × 1¼	181	52·0	**2·79**	8·69	**1·21**	2·39	**$1+0{\cdot}77a_Y$**	$1+0{\cdot}14a_X$
"	" × 1	160½	46·0	**2·69**	8·48	**1·23**	2·39	**$1+0{\cdot}83a_Y$**	$1+0{\cdot}14a_X$
"	" × ⅞	150	43·0	**2·63**	8·37	**1·24**	2·39	**$1+0{\cdot}87a_Y$**	$1+0{\cdot}14a_X$
"	" × ¾	140	40·0	**2·56**	8·26	**1·25**	2·40	**$1+0{\cdot}92a_Y$**	$1+0{\cdot}15a_X$
"	" × ⅝	130	37·0	**2·47**	8·13	**1·27**	2·40	**$1+0{\cdot}98a_Y$**	$1+0{\cdot}15a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

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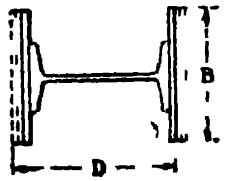


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches	HEIGHTS IN FEET.													
		10	12	14	16	18	20	22	24	26	28	30	32	34	36
218 K	19 × 12	352	347	342	335	327	319	310	300	289	249	217	191	169	150
216 K	18½ × "	313	308	303	296	289	282	273	264	243	210	183	161	142	127
214 K	18 × "	273	269	264	258	251	241	236	227	198	171	149	131	116	103
213 K	17¾ × "	253	249	244	238	232	225	217	206	175	151	132	116	102	
212 K	17½ × "	233	229	224	219	212	206	198	179	153	132	115	101	89·4	
211 K	17¼ × "	213	209	204	199	193	186	179	153	130	112	97·8	85·9		
210 K	17 × "	193	189	184	179	173	166	150	126	107	92 8	80·8			
198 K	18 × 12	347	342	336	330	323	315	306	296	286	249	217	191	169	158
196 K	17½ × "	307	303	298	292	285	277	269	260	244	210	183	161	143	127
194 K	17 × "	267	263	259	253	247	240	232	224	199	171	149	131	116	104
193 K	16¾ × "	248	244	239	234	227	221	213	206	176	152	132	116	103	91 9
192 K	16½ × "	228	224	219	214	208	202	195	180	153	132	115	101	89 8	
191 K	16¼ × "	208	204	200	194	189	182	175	154	131	113	98·3	86 4		
190 K	16 × "	188	184	180	174	169	162	151	127	108	93·4	81·4	71 5		
178 K	17 × 12	343	338	333	327	320	312	303	294	284	249	217	191	169	151
176 K	16½ × "	303	299	294	288	282	274	266	258	244	210	183	155	142	127
174 K	16 × "	264	260	255	250	244	237	229	222	199	171	149	131	116	103
173 K	15¾ × "	244	240	236	230	224	218	211	203	176	152	132	116	103	91 8
172 K	15½ × "	224	220	216	211	205	199	192	180	153	132	115	101	89·7	
171 K	15¼ × "	204	201	196	191	186	179	173	153	131	113	98·2	86·3	76·4	
170 K	15 × "	184	181	176	171	166	160	151	127	108	93·2	81·1	71·3		

Rivets ¾ in diam. at 6 in. pitch

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

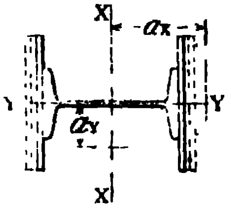
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
16 × 6	12 × 1½	187	54·2	**2·91**	8·02	**1·20**	2·41	**1 + 0·71a_Y**	1 + 0·15a_X
"	" × 1¼	166½	48·2	**2·83**	7·83	**1·21**	2·40	**1 + 0·75a_Y**	1 + 0·15a_X
"	" × 1	146	42·2	**2·73**	7·63	**1·22**	2·39	**1 + 0·81a_Y**	1 + 0·16a_X
"	" × ⅞	136	39·2	**2·66**	7·52	**1·23**	2·39	**1 + 0·85a_Y**	1 + 0·16a_X
"	" × ¾	125½	36·2	**2·59**	7·41	**1·25**	2·40	**1 + 0·90a_Y**	1 + 0·16a_X
"	" × ⅝	115½	33·2	**2·49**	7·28	**1·27**	2·40	**1 + 0·97a_Y**	1 + 0·16a_X
"	" × ½	105½	30·2	**2·38**	7·14	**1·29**	2·42	**1 + 1·06a_Y**	1 + 0·17a_X
15 × 6	12 × 1½	184	53·3	**2·93**	7·60	**1·18**	2·40	**1 + 0·70a_Y**	1 + 0·16a_X
"	" × 1¼	163½	47·3	**2·86**	7·43	**1·18**	2·39	**1 + 0·73a_Y**	1 + 0·16a_X
"	" × 1	143	41·3	**2·76**	7·24	**1·20**	2·38	**1 + 0·79a_Y**	1 + 0·16a_X
"	" × ⅞	133	38·3	**2·70**	7·13	**1·21**	2·38	**1 + 0·82a_Y**	1 + 0·17a_X
"	" × ¾	122½	35·3	**2·63**	7·03	**1·22**	2·38	**1 + 0·87a_Y**	1 + 0·17a_X
"	" × ⅝	112½	32·3	**2·53**	6·91	**1·24**	2·38	**1 + 0·93a_Y**	1 + 0·17a_X
"	" × ½	102½	29·3	**2·42**	6·78	**1·26**	2·39	**1 + 1·02a_Y**	1 + 0·18a_X
14 × 6*a*	12 × 1½	182	52·7	**2·95**	7·15	**1·17**	2·41	**1 + 0·69a_Y**	1 + 0·17a_X
"	" × 1¼	161½	46·7	**2·88**	6·98	**1·18**	2·40	**1 + 0·73a_Y**	1 + 0·17a_X
"	" × 1	141	40·7	**2·78**	6·80	**1·20**	2·39	**1 + 0·78a_Y**	1 + 0·18a_X
"	" × ⅞	131	37·7	**2·72**	6·70	**1·20**	2·38	**1 + 0·81a_Y**	1 + 0·18a_X
"	" × ¾	120½	34·7	**2·65**	6·59	**1·22**	2·38	**1 + 0·86a_Y**	1 + 0·18a_X
"	" × ⅝	110½	31·7	**2·56**	6·48	**1·23**	2·38	**1 + 0·92a_Y**	1 + 0·18a_X
"	" × ½	100½	28·7	**2·44**	6·36	**1·25**	2·39	**1 + 1·01a_Y**	1 + 0·19a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

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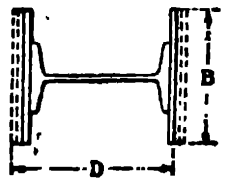


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET													
		10	12	14	16	18	20	22	24	26	28	30	32	34	36
158 K	17 × 12	322	318	313	308	302	295	287	278	270	246	214	188	167	149
156 K	16½ × "	283	279	275	270	264	257	250	243	235	207	180	158	140	125
154 K	16 × "	243	240	236	231	226	220	214	207	195	168	146	128	114	101
153 K	15¾ × "	224	220	216	212	207	201	195	188	172	148	129	113	100	89·7
152 K	15½ × "	204	201	197	193	188	182	176	170	149	129	112	98·6	87·4	77·9
151 K	15¼ × "	184	181	177	173	168	163	158	149	127	109	95·2	83·7	74·1	
150 K	15 × "	164	161	158	154	149	144	139	122	104	89·8	78·3	68·8		
138 K	15 × 12	337	333	328	322	315	307	299	290	280	249	217	191	169	151
136 K	14½ × "	298	294	289	283	277	270	262	254	244	211	183	161	143	127
134 K	14 × "	258	254	250	245	239	232	225	218	199	171	149	131	116	104
133 K	13¾ × "	238	235	230	225	220	214	207	199	176	152	132	116	103	91·9
132 K	13½ × "	219	215	211	206	201	195	188	180	153	132	115	101	89·8	
131 K	13¼ × "	199	195	191	187	181	175	169	154	131	113	98·4	86·5	76·6	
130 K	13 × "	179	175	171	167	162	156	150	127	108	93·4	81·4	71·5		
118 K	15 × 12	319	315	310	304	298	291	284	276	267	246	214	188	167	149
116 K	14½ × "	279	276	271	266	261	254	248	240	232	207	180	159	140	125
114 K	14 × "	240	236	232	228	223	217	211	204	195	168	146	129	114	102
113 K	13¾ × "	220	217	213	209	204	198	192	186	172	149	129	114	101	90·0
112 K	13½ × "	200	197	194	189	185	180	174	168	150	129	112	98·9	87·6	78·2
111 K	13¼ × "	180	177	174	170	166	161	155	149	127	109	95·5	83·9	74·4	
110 K	13 × "	160	158	154	150	146	141	136	123	104	90·2	78·6	69·0	61·1	

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

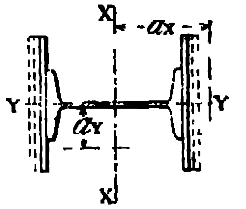
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
14 × 6*b*	12 × 1½	171	49·5	**3·02**	7·26	**1·13**	2·37	$1+0{\cdot}66a_Y$	$1+0{\cdot}16a_X$
"	" × 1¼	150½	43·5	**2·96**	7·09	**1·14**	2·36	$1+0{\cdot}69a_Y$	$1+0{\cdot}17a_X$
"	" × 1	130	37·5	**2·87**	6·91	**1·15**	2·34	$1+0{\cdot}73a_Y$	$1+0{\cdot}17a_X$
"	" × ⅞	120	34·5	**2·81**	6·81	**1·15**	2·34	$1+0{\cdot}76a_Y$	$1+0{\cdot}17a_X$
"	" × ¾	109½	31·5	**2·74**	6·71	**1·16**	2·34	$1+0{\cdot}80a_Y$	$1+0{\cdot}17a_X$
"	" × ⅝	99½	28·5	**2·66**	6·60	**1·17**	2·34	$1+0{\cdot}85a_Y$	$1+0{\cdot}18a_X$
"	" × ½	89½	25·5	**2·54**	6·48	**1·19**	2·34	$1+0{\cdot}93a_Y$	$1+0{\cdot}18a_X$
12 × 6*a*	12 × 1½	179	51·8	**2·98**	6·24	**1·17**	2·45	$1+0{\cdot}68a_Y$	$1+0{\cdot}19a_X$
"	" × 1¼	158½	45·8	**2·91**	6·08	**1·18**	2·42	$1+0{\cdot}71a_Y$	$1+0{\cdot}20a_X$
"	" × 1	138	39·8	**2·81**	5·91	**1·19**	2·41	$1+0{\cdot}76a_Y$	$1+0{\cdot}20a_X$
"	" × ⅞	128	36·8	**2·75**	5·81	**1·20**	2·40	$1+0{\cdot}79a_Y$	$1+0{\cdot}21a_X$
"	" × ¾	117½	33·8	**2·68**	5·72	**1·21**	2·40	$1+0{\cdot}83a_Y$	$1+0{\cdot}21a_X$
"	" × ⅝	107½	30·8	**2·59**	5·61	**1·22**	2·39	$1+0{\cdot}89a_Y$	$1+0{\cdot}21a_X$
"	" × ½	97½	27 8	**2·48**	5·50	**1·24**	2·40	$1+0{\cdot}97a_Y$	$1+0{\cdot}22a_X$
12 × 6*b*	12 × 1½	169	48·9	**3·04**	6·33	**1·13**	2·41	$1+0{\cdot}65a_Y$	$1+0{\cdot}19a_X$
"	" × 1¼	148½	42·9	**2·98**	6·17	**1·14**	2·38	$1+0{\cdot}68a_Y$	$1+0{\cdot}19a_X$
"	" × 1	128	36·9	**2·90**	6·00	**1·14**	2·36	$1+0{\cdot}72a_Y$	$1+0{\cdot}20a_X$
"	" × ⅞	118	33·9	**2·84**	5·91	**1·15**	2·35	$1+0{\cdot}74a_Y$	$1+0{\cdot}20a_X$
"	" × ¾	107½	30·9	**2·77**	5·82	**1·16**	2·35	$1+0{\cdot}78a_Y$	$1+0{\cdot}20a_X$
"	" × ⅝	97½	27·9	**2·69**	5·72	**1·17**	2·34	$1+0{\cdot}83a_Y$	$1+0{\cdot}20a_X$
"	" × ½	87½	24·9	**2·58**	5·61	**1·18**	2·35	$1+0{\cdot}90a_Y$	$1+0{\cdot}21a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2¼ per cent. over this must be allowed. See page 7.

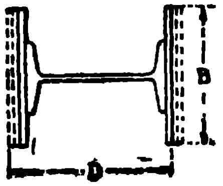
Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W_e=actual eccentric load; K=relative eccentricity coefficient; W_c=equivalent concentric value; $W_c = W_e \times K$.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D×B inches.	HEIGHTS IN FEET.													
		10	12	14	16	18	20	22	24	26	28	30	32	34	36
102 K	13½ × 10	156	152	148	144	139	133	118	99·4	84·7	73·0	63·6			
101 K	13¼ × "	139	136	132	128	123	118	100	84·0	71·6	61·7	53·8			
100 K	13 × "	123	120	116	112	107	98·9	81·8	68·7	58·5	50·5				
99 K	12¾ × "	106	103	99·9	95·9	91·5	76·7	63·4	53·3	45·4					
92 K	14 × 14	503	498	493	487	480	472	463	454	444	433	422	409	363	323
90 K	13½ × "	456	452	447	441	435	428	420	411	402	392	381	362	321	286
88 K	13 × "	410	406	402	396	390	383	376	368	359	350	340	314	278	248
86 K	12½ × 12	328	324	319	313	306	298	290	281	271	234	204	179	159	142
84 K	12 × ".	289	285	280	274	268	261	253	244	226	195	170	149	132	118
83 K	11¾ × "	269	265	260	255	249	242	234	226	203	175	153	134	119	106
82 K	11½ × "	249	245	241	235	229	223	216	208	181	156	136	119	106	94·3
81 K	11¼ × "	230	226	221	216	210	204	197	185	158	136	119	104	92·5	
80 K	11 × "	210	206	201	196	191	184	178	159	136	117	102	89·6	79·3	
68 K	13 × 12	315	311	306	301	295	288	281	273	265	247	215	189	167	149
66 K	12½ × "	275	272	268	263	257	251	245	238	230	208	181	159	141	125
64 K	12 × "	236	233	229	225	220	214	208	202	195	168	147	129	114	102
63 K	11¾ × "	216	213	210	205	201	195	190	184	173	149	130	114	101	90·2
62 K	11½ × "	197	194	190	186	182	177	171	165	150	129	113	99·2	87·8	78·3
61 K	11¼ × "	177	174	171	167	163	158	153	147	127	110	95·8	84·2	74·6	66·5
60 K	11 × 10	141	138	134	129	124	113	93·2	78·3	66·7	57·6				
59 K	10¾ × "	125	121	117	113	107	90·8	75·0	63 0	53·7					

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

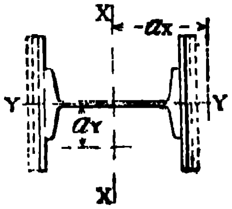
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
12 × 5	10 × ¾	85½	24·4	**2·35**	5·83	**1·16**	2·34	**1 + 0·91a_Y**	1 + 0·20a_X
"	" × ⅝	77	21·9	**2·28**	5·72	**1·17**	2·34	**1 + 0·96a_Y**	1 + 0·20a_X
"	" × ½	68½	19·4	**2·19**	5·60	**1·18**	2·35	**1 + 1·04a_Y**	1 + 0·21a_X
"	" × ⅜	60	16·9	**2·06**	5·47	**1·21**	2·36	**1 + 1·17a_Y**	1 + 0·21a_X
10 × 8	14 × 2	264	76·6	**3·59**	5·57	**1·17**	2·58	**1 + 0·55a_Y**	1 + 0·23a_X
"	" × 1¾	240½	69·6	**3·54**	5·42	**1·17**	2·55	**1 + 0·56a_Y**	1 + 0·23a_X
"	" × 1½	216½	62·6	**3·48**	5·27	**1·18**	2·52	**1 + 0·58a_Y**	1 + 0·24a_X
"	12 × 1¼	176	50·6	**2·92**	5·06	**1·21**	2·52	**1 + 0·71a_Y**	1 + 0·25a_X
"	" × 1	155½	44·6	**2·84**	4·90	**1·23**	2·50	**1 + 0·75a_Y**	1 + 0·25a_X
"	" × ⅞	145	41·6	**2·79**	4·82	**1·23**	2·49	**1 + 0·77a_Y**	1 + 0·25a_X
"	" × ¾	135	38·6	**2·73**	4·73	**1·24**	2·48	**1 + 0·81a_Y**	1 + 0·26a_X
"	" × ⅝	125	35·6	**2·66**	4·65	**1·26**	2·47	**1 + 0·85a_Y**	1 + 0·26a_X
"	" × ½	114½	32·6	**2·57**	4·55	**1·27**	2·46	**1 + 0·91a_Y**	1 + 0·27a_X
10 × 6	12 × 1½	167	48·3	**3·06**	5·39	**1·13**	2·45	**1 + 0·64a_Y**	1 + 0·23a_X
"	" × 1¼	146½	42·3	**3·00**	5·24	**1·13**	2·42	**1 + 0·67a_Y**	1 + 0·23a_X
"	" × 1	126	36·3	**2·92**	5·08	**1·14**	2·40	**1 + 0·70a_Y**	1 + 0·23a_X
"	" × ⅞	116	33·3	**2·87**	5·00	**1·15**	2·38	**1 + 0·73a_Y**	1 + 0·24a_X
"	" × ¾	105½	30·3	**2·80**	4·91	**1·15**	2·37	**1 + 0·76a_Y**	1 + 0·24a_X
"	" × ⅝	95½	27·3	**2·72**	4·82	**1·16**	2·36	**1 + 0·81a_Y**	1 + 0·24a_X
"	10 × ½	78½	22·3	**2·18**	4·67	**1·21**	2·39	**1 + 1·06a_Y**	1 + 0·25a_X
"	" × ⅜	70	19·8	**2·07**	4·56	**1·23**	2·39	**1 + 1·16a_Y**	1 + 0·26a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

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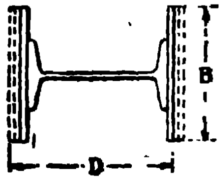


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons. Ends Flat.

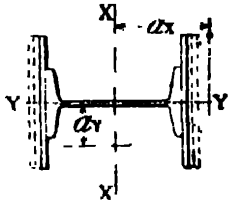
Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	10	12	14	16	18	20	22	24	26	28	30	32	34
54 K	12 × 10	188	185	181	177	172	167	161	154	130	111	95·7	83·4	73·3	
53 K	11¾ × ″	171	168	165	161	157	151	146	137	115	98·0	84·5	73·6	64·7	
52 K	11½ × ″	155	152	149	145	141	136	131	118	99·5	84·8	73·1	63·7		
51 K	11¼ × 9	129	126	123	118	114	108	91·0	75·3	63·2	53·9				
50 K	11 × ″	114	111	108	104	99·7	92·5	74·9	61·9	52·0	44·3				
49 K	10¾ × ″	99·5	96·7	93·4	89·6	85·2	72·6	58·8	48·6	40·8					
38 K	12 × 12	349	345	341	335	329	322	315	307	297	288	259	226	198	176
36 K	11½ × ″	309	306	302	297	291	285	278	270	262	253	220	192	169	149
34 K	11 × ″	269	266	262	258	253	247	240	233	226	210	181	158	139	123
33 K	10¾ × 10	224	221	216	210	204	197	189	169	142	121	104	90·7		
32 K	10½ × ″	208	204	200	194	188	181	174	150	126	108	92·9	80·9		
31 K	10¼ × ″	191	188	183	178	172	166	159	132	111	94·6	81·6	71·1		
30 K	10 × ″	175	171	167	162	156	150	138	114	95·6	81·5	70·2			
24 K	10 × 10	197	194	190	186	181	175	169	162	136	116	100	87·2	76·6	
23 K	9¾ × ″	181	178	174	170	165	160	154	144	121	103	88·8	77·3	68·0	
22 K	9½ × ″	164	162	158	154	150	144	139	125	105	89·9	77·5	67·5		
21 K	9¼ × 9	139	136	132	127	123	117	99·8	82·5	69·3	59·1				
20 K	9 × ″	124	121	117	113	108	103	83·6	69·1	58·0	49·5				
19 K	8¾ × ″	109	106	103	98·8	94·2	83·3	67·5	55·8	46·8					
14 K	10 × 10	184	181	178	174	169	164	158	152	130	111	95·9	83·6	73·4	
13 K	9¾ × ″	168	165	162	158	154	149	143	137	115	98·1	84·6	73·7	64·8	
12 K	9½ × ″	151	149	146	142	138	133	128	119	99·8	85·0	73·3	63·9	*56·1*	
11 K	9¼ × 9	126	123	119	116	111	106	91·5	75·6	63·6	54·2	46·7			
10 K	9 × ″	111	108	105	101	97·2	92·5	75·4	62·4	52·4	44·6				
9 K	8¾ × ″	96·0	93·5	90·4	86·9	82·9	73·3	59·3	49·0	41·2					

Rivets ¾-in diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line
For other conditions and formulæ, see notes commencing page 192.
The safe load printed in italics is for a height greater than 40D.
For explanations of properties, &c., see Part IV

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
10 × 5	10 × 1	100½	28·8	**2·47**	5·11	**1·15**	2·38	**$1+0{\cdot}82a_Y$**	$1+0{\cdot}23a_X$
"	" × ⅞	92	26·3	**2·43**	5·02	**1·15**	2·37	**$1+0{\cdot}85a_Y$**	$1+0{\cdot}23a_X$
"	" × ¾	83½	23·8	**2·38**	4·93	**1·16**	2·36	**$1+0{\cdot}89a_Y$**	$1+0{\cdot}24a_X$
"	9 × ⅝	70½	20·0	**2·06**	4·80	**1·19**	2·37	**$1+1{\cdot}06a_Y$**	$1+0{\cdot}24a_X$
"	" × ½	63	17·8	**1·99**	4·70	**1·21**	2·37	**$1+1{\cdot}14a_Y$**	$1+0{\cdot}25a_X$
"	" × ⅜	55½	15·5	**1·88**	4·58	**1·23**	2·38	**$1+1{\cdot}27a_Y$**	$1+0{\cdot}26a_X$
9 × 7	12 × 1½	184	53·0	**3·00**	4·81	**1·19**	2·56	**$1+0{\cdot}67a_Y$**	$1+0{\cdot}26a_X$
"	" × 1¼	164	47·0	**2·94**	4·66	**1·19**	2·53	**$1+0{\cdot}70a_Y$**	$1+0{\cdot}27a_X$
"	" × 1	143½	41·0	**2·85**	4·50	**1·20**	2·50	**$1+0{\cdot}74a_Y$**	$1+0{\cdot}27a_X$
"	10 × ⅞	121½	34·5	**2·35**	4·36	**1·25**	2·52	**$1+0{\cdot}90a_Y$**	$1+0{\cdot}28a_X$
"	" × ¾	113	32·0	**2·31**	4·28	**1·26**	2·51	**$1+0{\cdot}94a_Y$**	$1+0{\cdot}29a_X$
"	" × ⅝	104½	29·5	**2·25**	4·19	**1·27**	2·50	**$1+0{\cdot}98a_Y$**	$1+0{\cdot}29a_X$
"	" × ½	96	27·0	**2·19**	4·10	**1·29**	2·49	**$1+1{\cdot}05a_Y$**	$1+0{\cdot}30a_X$
8 × 6	10 × 1	105½	30·3	**2·47**	4·13	**1·18**	2·47	**$1+0{\cdot}82a_Y$**	$1+0{\cdot}29a_X$
"	" × ⅞	97	27·8	**2·42**	4·05	**1·19**	2·45	**$1+0{\cdot}85a_Y$**	$1+0{\cdot}30a_X$
"	" × ¾	88½	25·3	**2·37**	3·97	**1·20**	2·43	**$1+0{\cdot}89a_Y$**	$1+0{\cdot}30a_X$
"	9 × ⅝	75½	21·5	**2·09**	3·85	**1·23**	2·44	**$1+1{\cdot}03a_Y$**	$1+0{\cdot}31a_X$
"	" × ½	68	19·3	**2·02**	3·76	**1·24**	2·43	**$1+1{\cdot}11a_Y$**	$1+0{\cdot}32a_X$
"	" × ⅜	60½	17·0	**1·93**	3·66	**1·27**	2·43	**$1+1{\cdot}21a_Y$**	$1+0{\cdot}33a_X$
8 × 5	10 × 1	98½	28·2	**2·50**	4·19	**1·14**	2·43	**$1+0{\cdot}80a_Y$**	$1+0{\cdot}29a_X$
"	" × ⅞	90	25·7	**2·46**	4·11	**1·15**	2·41	**$1+0{\cdot}83a_Y$**	$1+0{\cdot}29a_X$
"	" × ¾	81½	23·2	**2·41**	4·03	**1·15**	2·39	**$1+0{\cdot}86a_Y$**	$1+0{\cdot}29a_X$
"	9 × ⅝	69	19·5	**2·10**	3·91	**1·18**	2·40	**$1+1{\cdot}02a_Y$**	$1+0{\cdot}30a_X$
"	" × ½	61	17·2	**2·03**	3·82	**1·19**	2·39	**$1+1{\cdot}10a_Y$**	$1+0{\cdot}31a_X$
"	" × ⅜	53½	15·0	**1·93**	3·72	**1·21**	2·38	**$1+1{\cdot}21a_Y$**	$1+0{\cdot}32a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

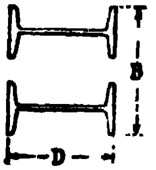
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

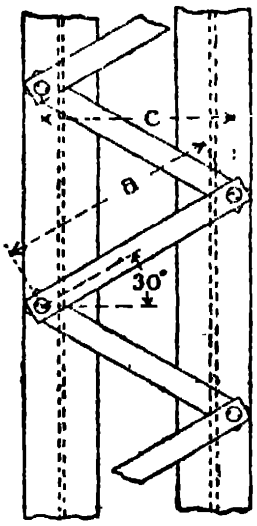
REDPATH, BROWN & CO., LIMITED.



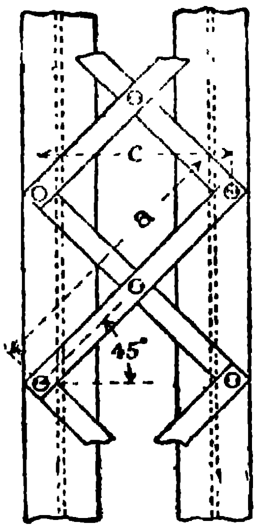
COMPOUND STANÇHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

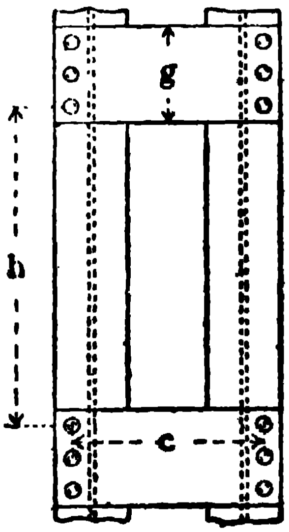
Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	12	16	20	24	26	28	30	32	34	36	38	40	44
30 L	24 × 26	393	392	391	389	387	386	385	383	382	380	379	377	375	371
29 L	20 × 23	349	348	347	344	342	341	339	337	336	334	332	330	327	322
28 L	18 × 21	294	293	292	289	287	285	284	282	280	278	276	274	272	267
27 L	16 × 18	243	242	240	237	234	233	231	229	227	225	222	220	217	212
26 L	15 × 17	231	229	227	225	221	220	218	215	213	211	208	205	202	196
25 L	15 × 16	164	163	162	160	157	156	155	153	151	150	148	146	144	139
24 L	14 × 17	223	222	220	217	214	212	210	208	206	204	201	198	196	190
23 L	14 × 17	180	179	177	175	173	171	170	168	166	164	162	160	158	153



SINGLE LATTICING.
Suitable for values of *c*, not exceeding 15 inches.



DOUBLE LATTICING.

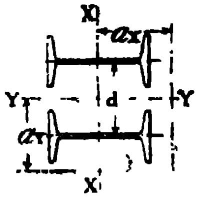


BATTEN PLATES.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formula for stanchions of mild steel having "both ends flat."
Safe loads for the condition of "both ends fixed" are identical with tabular loads for the above heights.
For other conditions and formulæ, see notes commencing page 192.
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of two Steel Joists Latticed.	Weight per foot in lbs.	Area in square inches.	d. Centres of Webs, Inches.	Radii of Gyration.		Eccentricity Coefficients.			
				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
24 × 7½	200	58·8	18·5	**9·37**	9·50	**2·42**	2·60	$1+0{\cdot}15a_Y$	$1+0{\cdot}13a_X$
20 × 7½	178	52·3	15·5	**7·90**	7·99	**2·48**	2·57	$1+0{\cdot}19a_Y$	$1+0{\cdot}16a_X$
18 × 7	150	44·1	14·0	**7·15**	7·22	**2·50**	2·56	$1+0{\cdot}21a_Y$	$1+0{\cdot}17a_X$
16 × 6	124	36·4	12·0	**6·12**	6·31	**2·51**	2·61	$1+0{\cdot}24a_Y$	$1+0{\cdot}20a_X$
15 × 6	118	34·7	11·0	**5·64**	6·02	**2·53**	2·55	$1+0{\cdot}27a_Y$	$1+0{\cdot}21a_X$
15 × 5	84	24·7	11·0	**5·59**	5·89	**2·47**	2·62	$1+0{\cdot}26a_Y$	$1+0{\cdot}22a_X$
14 × 6*a*	114	33·5	11·0	5·65	**5·64**	2·53	**2·54**	$1+0{\cdot}27a_Y$	$1+0{\cdot}22a_X$
14 × 6*b*	92	27·0	11·0	**5·64**	5·70	**2·52**	2·51	$1+0{\cdot}27a_Y$	$1+0{\cdot}22a_X$

CONVENTIONAL MAXIMUM SPACING AND MINIMUM PROPORTIONS OF LATTICE BARS AND BATTEN PLATES FOR CONCENTRIC LOADING (*Am. Ry. Engineering and Maintenance of Way Assoc.*).

Width of Joist Flange. Inches.	7½	7	6	5
Width of Lattice Bar. Inches.	2½	2½	2¼	2¼
Diameter of Rivet.	⅞	⅞	¾	¾

SINGLE LATTICING—
Maximum angle of inclination with horizontal = 30 degrees.
Minimum thickness = 1/40th of a, the diagonal centres of rivets.
Maximum horizontal centres of rivets, c = 15 inches.

DOUBLE LATTICING—
Maximum angle of inclination with horizontal = 45 degrees.
Minimum thickness = 1/60th of a, the diagonal centres of rivets.

BATTEN PLATES—
Maximum centres of end rivets of batten plates = h inches.
Let l = height of stanchion in inches, and k = radius of gyration of one joist.
Then $h = \dfrac{l \times k \text{ least.}}{k \text{ greatest.}}$
Minimum thickness = 1/50th of c, the horizontal centres of rivets.
Minimum width $g = c$, the horizontal centres of rivets for end plates.
" " $g = \frac{1}{2}c$, " " " intermediate plates.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

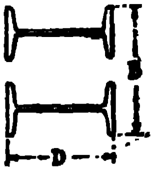
Each weight per foot is for the shaft only. Weights of lattices, bases, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

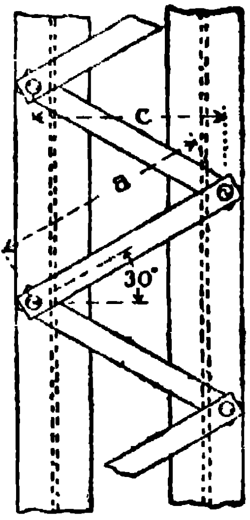
For full explanations of tables, see notes commencing page 192.



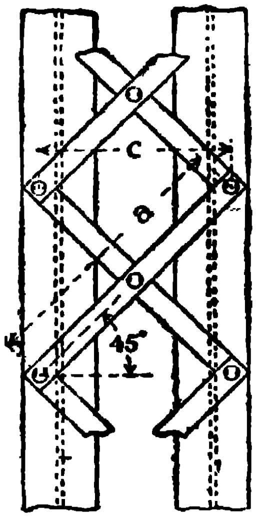
COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

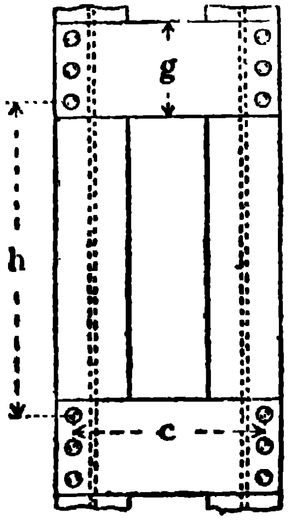
Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	12	16	20	22	24	26	28	30	32	34	36	38	40
22 L	12 × 15	211	209	206	203	201	198	196	193	190	187	184	181	177	173
21 L	12 × 15	172	170	168	165	163	162	160	157	155	153	150	147	144	141
20 L	12 × 14	125	124	122	120	118	117	116	114	112	110	108	106	104	102
18 L	10 × 13	163	161	158	153	151	148	145	142	138	135	*128*	*114*	*102*	*92·6*
17 L	10 × 12	116	115	112	109	107	105	103	100	97·9	95·3	*86·7*	*77·3*	*69·4*	*62·6*
15 L	9 × 11	81·7	80·4	78·5	76·2	74·8	73·3	71·7	70·0	68·2	*66·2*	*58·7*	*52·4*	*47·0*	*42·4*
14 L	8 × 12	136	133	129	125	122	119	116	*112*	*106*	*91·8*	*81·3*	*72·5*	*65·1*	*58·7*
13 L	8 × 11	108	106	103	99·3	97·0	94·5	91·8	*89·0*	*79·7*	*70·1*	*62·1*	*55·4*	*49·7*	*44·8*



SINGLE LATTICING.
Suitable for values of *c*, not exceeding 15 inches.



DOUBLE LATTICING.

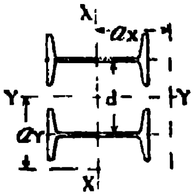


BATTEN PLATES.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.
For other conditions and formulæ, see notes commencing page 192.
Safe loads printed in italics are for heights greater than 40D.
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of two Steel Joists Latticed.	Weight per foot in lbs.	Area in square inches.	d. Centres of Webs. Inches.	Radii of Gyration.		Eccentricity Coefficients.			
				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
12 × 6*a*	108	31·7	9·0	**4·69**	4·86	**2·62**	3·52	$1 + 0{\cdot}34a_Y$	$1 + 0{\cdot}26a_X$
12 × 6*b*	88	25·9	9·0	**4·68**	4·93	**2·61**	2·48	$1 + 0{\cdot}34a_Y$	$1 + 0{\cdot}25a_X$
12 × 5	64	18·8	9·0	**4·61**	4·83	**2·54**	2·54	$1 + 0{\cdot}33a_Y$	$1 + 0{\cdot}26a_X$
10 × 6	84	24·7	7·0	**3·75**	4·14	**2·71**	2·46	$1 + 0{\cdot}46a_Y$	$1 + 0{\cdot}29a_X$
10 × 5	60	17·6	7·0	**3·65**	4·06	**2·65**	2·52	$1 + 0{\cdot}45a_Y$	$1 + 0{\cdot}30a_X$
9 × 4	42	12·3	7·0	**3·59**	3·62	**2·55**	2·54	$1 + 0{\cdot}43a_Y$	$1 + 0{\cdot}34a_X$
8 × 6	70	20·6	6·0	**3·27**	3·28	**2·80**	2·49	$1 + 0{\cdot}56a_Y$	$1 + 0{\cdot}37a_X$
8 × 5	56	16·5	6·0	**3·20**	3·29	**2·71**	2·48	$1 + 0{\cdot}54a_Y$	$1 + 0{\cdot}37a_X$

CONVENTIONAL MAXIMUM SPACING AND MINIMUM PROPORTIONS OF LATTICE BARS AND BATTEN PLATES FOR CONCENTRIC LOADING (*Am. Ry. Engineering and Maintenance of Way Assoc.*).

Width of Joist Flange. Inches.	6	5	4
Width of Lattice Bar. Inches.	2¼	2¼	2
Diameter of Rivet.	¾	¾	⅝

SINGLE LATTICING—
Maximum angle of inclination with horizontal = 60 degrees.
Minimum thickness = 1/40th of *a*, the diagonal centres of rivets.
Maximum horizontal centres of rivets, *c* = 15 inches.

DOUBLE LATTICING—
Maximum angle of inclination with horizontal = 45 degrees.
Maximum thickness = 1/60th of *a*, the diagonal centres of rivets.

BATTEN PLATES—
Maximum centres of end rivets of batten plates = *h* inches.
Let *l* = height of stanchion in inches, and *k* = radius of gyration of one joist.

$$\text{Then } h = \frac{l \times k \text{ least.}}{k \text{ greatest.}}$$

Minimum thickness = 1/50th of *c*, the horizontal centres of rivets.
Minimum width *g* = *c*, the horizontal centres of rivets for end plates.
" " *g* = ½*c*, " " " intermediate plates.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weights of lattices, bases, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

For Stanchions in Buildings of Steel Skeleton Construction in London (see Part VI.)

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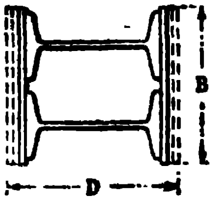


COMPOUND STANCHIONS

Safe Concentric Loads, in Tons.
Ends Flat.

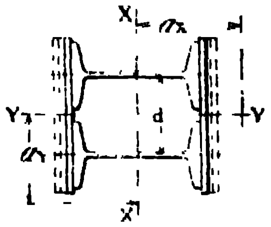
Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	12	16	20	24	28	30	32	34	36	38	40	42	44
282 M	28 × 24	1033	1028	1021	1013	1002	990	982	975	967	959	950	941	931	920
280 M	27½ × "	952	948	942	934	924	912	906	899	892	884	876	867	858	848
278 M	27 × "	872	868	863	855	846	836	829	823	816	809	801	794	785	776
276 M	26½ × "	792	789	783	776	768	758	753	747	741	734	727	720	712	704
274 M	26 × "	712	709	704	698	690	681	676	671	665	659	653	646	639	632
273 M	25¾ × 20	624	620	614	606	597	585	579	572	565	557	549	541	532	523
272 M	25½ × "	591	587	581	574	565	554	548	541	534	527	520	512	503	495
271 M	25¼ × 18	540	536	529	521	511	498	491	484	476	469	460	451	442	424
262 M	24 × 24	990	985	979	970	960	949	942	935	927	919	911	902	893	883
260 M	23½ × "	909	905	899	892	883	872	865	859	852	845	837	828	820	811
258 M	23 × "	829	825	820	813	805	795	789	783	777	770	763	755	747	739
256 M	22½ × 20	681	677	670	662	652	640	633	626	618	610	602	593	584	574
254 M	22 × "	615	610	605	597	588	577	571	564	557	550	542	534	525	517
253 M	21¾ × "	581	577	572	565	556	545	539	533	527	520	512	504	496	488
252 M	21½ × "	548	544	539	532	524	514	508	502	496	489	482	475	467	452
251 M	21¼ × 18	498	493	487	480	470	459	453	446	439	432	424	416	408	393
242 M	22 × 18	773	766	757	746	732	716	707	697	686	676	664	652	640	627
240 M	21½ × "	713	707	699	688	675	660	651	642	633	623	612	601	589	577
238 M	21 × "	653	647	640	630	618	604	596	588	579	570	560	550	539	528
236 M	20½ × "	593	588	581	572	561	548	541	533	525	517	508	498	489	479
234 M	20 × "	533	528	522	514	504	492	486	479	472	464	456	447	438	429
233 M	19¾ × 16	479	474	467	457	446	433	425	418	409	401	392	371	336	307
232 M	19½ × "	452	447	441	432	421	408	402	394	386	378	370	348	316	288
231 M	19¼ × "	426	421	415	406	396	384	378	371	363	355	347	325	295	269

Rivets ⅞-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.
For other conditions and formulæ, see notes commencing page 192.
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	d. Centres of Webs in inches.	Radii of Gyration		Eccentricity Coefficients.			
Two Steel Joists.	Plates, each flange to form.				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
24 × 7½	24 × 2	530	154·8	12	**6·65**	11·80	**2·71**	2·41	**1 + 0·27a_Y**	1 + 0·10a_X
"	" × 1¾	489½	142·8	"	**6·63**	11·61	**2·72**	2·40	**1 + 0·27a_Y**	1 + 0·10a_X
"	" × 1½	448½	130·8	"	**6·60**	11·41	**2·74**	2·40	**1 + 0·28a_Y**	1 + 0·11a_X
"	" × 1¼	407½	118·8	"	**6·57**	11·19	**2·75**	2·40	**1 + 0·28a_Y**	1 + 0·11a_X
"	" × 1	364	106·8	"	**6·53**	10·95	**2·78**	2·41	**1 + 0·28a_Y**	1 + 0·11a_X
"	20 × ⅞	322½	93·8	10	**5·43**	10·69	**2·80**	2·45	**1 + 0·34a_Y**	1 + 0·11a_X
"	" × ¾	305½	88·8	"	**5·41**	10·56	**2·81**	2·46	**1 + 0·34a_Y**	1 + 0·12a_X
"	18 × ⅝	280	81·3	9	**4·87**	10·36	**2·82**	2·48	**1 + 0·38a_Y**	1 + 0·12a_X
20 × 7½	24 × 2	508	148·3	12	**6·68**	10·05	**2·70**	2·43	**1 + 0·27a_Y**	1 + 0·12a_X
"	" × 1¾	467½	136·3	"	**6·65**	9·87	**2·71**	2·42	**1 + 0·27a_Y**	1 + 0·12a_X
"	" × 1½	426½	124·3	"	**6·63**	9·69	**2·72**	2·41	**1 + 0·27a_Y**	1 + 0·12a_X
"	20 × 1¼	351½	102·3	10	**5·50**	9·37	**2·75**	2·44	**1 + 0·33a_Y**	1 + 0·13a_X
"	" × 1	318	92·3	"	**5·47**	9·16	**2·77**	2·44	**1 + 0·34a_Y**	1 + 0·13a_X
"	" × ⅞	300½	87·3	"	**5·45**	9·05	**2·78**	2·45	**1 + 0·34a_Y**	1 + 0·13a_X
"	" × ¾	283½	82·3	"	**5·43**	8·93	**2·80**	2·45	**1 + 0·34a_Y**	1 + 0·14a_X
"	18 × ⅝	258	74·8	9	**4·89**	8·75	**2·81**	2·47	**1 + 0·38a_Y**	1 + 0·14a_X
18 × 7	18 × 2	398½	116·1	9	**5·02**	9·05	**2·71**	2·48	**1 + 0·36a_Y**	1 + 0·14a_X
"	" × 1¾	368	107·1	"	**5·01**	8·88	**2·72**	2·47	**1 + 0·36a_Y**	1 + 0·14a_X
"	" × 1½	337½	98·1	"	**4·99**	8·71	**2·73**	2·46	**1 + 0·36a_Y**	1 + 0·14a_X
"	" × 1¼	307	89·1	"	**4·97**	8·52	**2·74**	2·45	**1 + 0·37a_Y**	1 + 0·14a_X
"	" × 1	276½	80·1	"	**4·94**	8·32	**2·76**	2·45	**1 + 0·37a_Y**	1 + 0·15a_X
"	16 × ⅞	249	72·1	8	**4·40**	8·15	**2·77**	2·47	**1 + 0·42a_Y**	1 + 0·15a_X
"	" × ¾	235½	68·1	"	**4·38**	8·04	**2·78**	2·47	**1 + 0·42a_Y**	1 + 0·15a_X
"	" × ⅝	222	64·1	"	**4·37**	7·93	**2·79**	2·47	**1 + 0·42a_Y**	1 + 0·16a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

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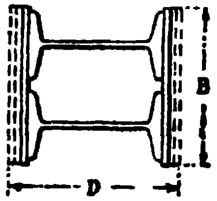


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	12	16	20	24	28	30	32	34	36	38	40	42	44
218 M	19 × 16	561	555	547	536	523	508	499	490	481	471	460	441	400	365
216 M	18½ × "	508	502	495	485	473	459	451	443	434	425	416	396	359	327
214 M	18 × "	454	449	443	434	423	411	404	396	388	380	371	351	318	290
213 M	17¾ × 14	404	398	390	380	367	353	345	336	327	295	265	239	217	198
212 M	17½ × "	380	375	367	358	346	332	325	317	308	277	248	224	203	185
211 M	17¼ × "	357	352	345	336	325	312	304	297	289	258	232	209	189	173
210 M	17 × "	334	329	322	314	303	291	284	277	268	239	215	194	176	160
198 M	18 × 16	549	543	535	525	512	497	489	480	471	461	451	434	394	359
196 M	17½ × "	496	491	483	474	462	449	441	433	425	416	407	389	353	322
194 M	17 × "	443	438	431	423	413	400	393	386	379	371	362	344	312	284
193 M	16¾ × 14	392	386	379	369	357	343	335	327	319	289	259	234	212	193
192 M	16½ × "	369	364	356	347	336	322	315	307	299	270	242	219	198	181
191 M	16¼ × "	345	341	334	325	314	302	295	288	280	252	226	204	185	168
190 M	16 × "	322	318	311	303	293	281	275	268	261	233	209	189	171	156
184 M	17 × 14	349	344	337	328	318	305	298	291	283	257	231	208	189	172
183 M	16¾ × "	326	321	315	306	296	285	278	271	264	238	214	193	175	159
182 M	16½ × "	302	298	292	284	275	264	258	252	245	219	197	178	161	147
181 M	16¼ × "	279	275	270	263	254	243	238	232	225	201	180	163	147	134
180 M	16 × "	256	252	247	241	232	223	218	212	204	182	163	147	134	122

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

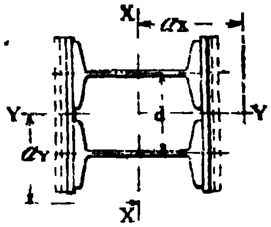
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	d. Centres of Webs in inches.	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Joists.	Plates, each flange to form.				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
16 × 6	16 × 1½	289½	84·4	8	**4·43**	7·80	**2·74**	2·49	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}16a_X$
"	" × 1¼	262½	76·4	"	**4·41**	7·61	**2·76**	2·48	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}16a_X$
"	" × 1	235	68·4	"	**4·39**	7·42	**2·78**	2·47	**$1+0{\cdot}42a_Y$**	$1+0{\cdot}17a_X$
"	14 × ⅞	210	60·9	7	**3·84**	7·24	**2·79**	2·50	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}17a_X$
"	" × ¾	198	57·4	"	**3·83**	7·13	**2·80**	2·51	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}17a_X$
"	" × ⅝	186	53·9	"	**3·82**	7·02	**2·81**	2·51	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ½	174	50·4	"	**3·80**	6·90	**2·83**	2·52	**$1+0{\cdot}49a_Y$**	$1+0{\cdot}18a_X$
15 × 6	16 × 1½	283½	82·7	8	**4·44**	7·40	**2·72**	2·48	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}17a_X$
"	" × 1¼	256½	74·7	"	**4·43**	7·23	**2·74**	2·47	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}17a_X$
"	" × 1	229½	66·7	"	**4·40**	7·04	**2·75**	2·46	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}17a_X$
"	14 × ⅞	204	59·2	7	**3·86**	6·88	**2·76**	2·48	**$1+0{\cdot}47a_Y$**	$1+0{\cdot}18a_X$
"	" × ¾	192	55·7	"	**3·84**	6·78	**2·78**	2·48	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ⅝	180	52·2	"	**3·83**	6·67	**2·79**	2·48	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ½	168	48·7	"	**3·82**	6·56	**2·80**	2·49	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}19a_X$
15 × 5	14 × 1	181½	52·7	7	**3·85**	7·09	**2·75**	2·44	**$1+0{\cdot}47a_Y$**	$1+0{\cdot}17a_X$
"	" × ⅞	170	49·2	"	**3·84**	6·98	**2·76**	2·44	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}17a_X$
"	" × ¾	158	45·7	"	**3·82**	6·87	**2·78**	2·44	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ⅝	146	42·2	"	**3·81**	6·75	**2·79**	2·45	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ½	134	38·7	"	**3·78**	6·62	**2·81**	2·46	**$1+0{\cdot}49a_Y$**	$1+0{\cdot}18a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

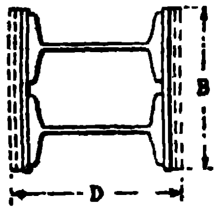
Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W_e = actual eccentric load ; K = relative eccentricity coefficient ; W_c = equivalent concentric value ; $W_c = W_e \times K$.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	12	16	20	24	28	30	32	34	36	38	40	42	44
168 M	17 × 16	541	536	528	518	505	491	482	474	465	455	445	429	389	355
166 M	16½ × ,,	488	483	476	467	455	442	435	427	419	410	401	384	348	317
164 M	16 × ,,	435	430	424	416	405	393	387	380	372	364	356	339	307	280
163 M	15¾ × 14	384	379	371	362	350	336	329	321	313	284	255	230	209	190
162 M	15½ × ,,	361	356	349	340	329	316	309	301	293	265	238	215	195	178
161 M	15¼ × ,,	338	333	326	318	307	295	288	281	274	247	221	200	181	165
160 M	15 × ,,	315	310	304	296	286	275	268	262	255	228	205	185	167	152
148 M	17 × 16	498	493	486	477	465	452	445	437	428	420	411	398	361	329
146 M	16½ × ,,	445	441	434	426	416	404	397	390	382	374	366	353	320	292
144 M	16 × ,,	392	388	382	375	366	355	349	343	336	329	322	308	279	254
143 M	15¾ × 14	341	337	330	322	311	299	293	285	278	254	228	206	187	170
142 M	15½ × ,,	318	314	308	300	290	279	272	266	259	235	211	191	173	157
141 M	15¼ × ,,	295	291	285	278	269	258	252	246	240	216	194	175	159	145
140 M	15 × ,,	272	268	263	256	247	237	232	226	220	198	177	160	145	132
128 M	15 × 14	488	482	473	461	446	429	420	410	400	371	333	301	273	248
126 M	14½ × ,,	442	436	428	417	404	388	380	371	361	334	299	270	245	223
124 M	14 × ,,	396	390	383	373	361	347	339	331	323	296	266	240	217	198
123 M	13¾ × ,,	372	367	360	351	340	326	319	311	303	277	249	224	204	185
122 M	13½ × ,,	349	344	338	329	318	306	299	292	284	259	232	209	190	173
121 M	13¼ × ,,	326	322	315	307	297	285	279	272	265	240	215	194	176	160
120 M	13 × ,,	303	299	293	285	276	265	259	252	246	221	198	179	162	*148*

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

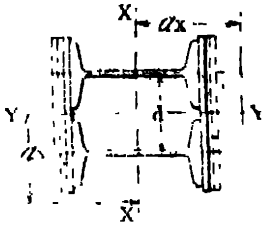
For other conditions and formulæ, see notes commencing page 192.

The safe load printed in italics is for a height greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs	Area in square inches	d. Centres of Webs in inches.	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Jo.	Plates, each flange to form.				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
[illegible] × 6a	16 × 1½	279½	81·5	8	**4·45**	6·97	**2·72**	2·49	**$1+0{\cdot}41a_y$**	$1+0{\cdot}18a_x$
"	" × 1¼	252½	73·5	"	**4·43**	6·79	**2·73**	2·48	**$1+0{\cdot}41a_y$**	$1+0{\cdot}18a_x$
"	" × 1	225½	[illegible]	"	**4·41**	6·61	**2·75**	2·46	**$1+0{\cdot}41a_y$**	$1+0{\cdot}18a_x$
"	14 × ⅞	200	58·0	7	**3·86**	6·46	**2·76**	2·49	**$1+0{\cdot}47a_y$**	$1+0{\cdot}19a_x$
"	" × ¾	183	[illegible]	"	**3·85**	6·36	**2·77**	2·48	**$1+0{\cdot}47a_y$**	$1+0{\cdot}19a_x$
"	" × ⅝	176	51·0	"	**3·84**	6·26	**2·78**	2·48	**$1+0{\cdot}48a_y$**	$1+0{\cdot}20a_x$
"	" × ½	161	[illegible]	"	**3·82**	6·15	**2·80**	[illegible]	**$1+0{\cdot}48a_y$**	$1+0{\cdot}20a_x$
[illegible] × 6b	16 × 1½	257½	75·0	8	**4·47**	7·09	**2·68**	2·44	**$1+0{\cdot}40a_y$**	$1+0{\cdot}17a_x$
"	" × 1¼	230½	67·0	"	**4·45**	6·92	**2·70**	2·42	**$1+0{\cdot}41a_y$**	$1+0{\cdot}17a_x$
"	" × 1	203½	59·0	"	**4·43**	6·74	**2·72**	2·41	**$1+0{\cdot}41a_y$**	$1+0{\cdot}18a_x$
"	14 × ⅞	178	51·5	7	**3·87**	6·59	**2·73**	2·43	**$1+0{\cdot}47a_y$**	$1+0{\cdot}18a_x$
"	" × ¾	166	48·0	"	**3·86**	6·49	**2·74**	2·43	**$1+0{\cdot}47a_y$**	$1+0{\cdot}19a_x$
"	" × ⅝	154	44·5	"	**3·85**	6·38	**2·75**	2·43	**$1+0{\cdot}47a_y$**	$1+0{\cdot}19a_x$
"	" × ½	142	41·0	"	**3·33**	6·27	**2·76**	2·43	**$1+0{\cdot}48a_y$**	$1+0{\cdot}19a_x$
12 × 6a	14 × 1½	253½	73·7	7	**3·91**	6·02	**2·71**	2·55	**$1+0{\cdot}46a_y$**	$1+0{\cdot}21a_x$
"	" × 1¼	229½	66·7	"	**3·90**	5·86	**2·72**	2·53	**$1+0{\cdot}46a_y$**	$1+0{\cdot}21a_x$
"	" × 1	205½	59·7	"	**3·88**	5·69	**2·74**	2·51	**$1+0{\cdot}47a_y$**	$1+0{\cdot}22a_x$
"	" × ⅞	194	56·2	"	**3·87**	5·60	**2·75**	2·51	**$1+0{\cdot}47a_y$**	$1+0{\cdot}22a_x$
"	" × ¾	182	52·7	"	**3·86**	5·51	**2·76**	2·50	**$1+0{\cdot}47a_y$**	$1+0{\cdot}22a_x$
"	" × ⅝	170	49·2	"	**3·85**	5·42	**2·77**	2·49	**$1+0{\cdot}47a_y$**	$1+0{\cdot}23a_x$
"	" × ½	158	45·7	"	**3·84**	5·32	**2·78**	2·49	**$1+0{\cdot}48a_y$**	$1+0{\cdot}23a_x$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load · K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192.

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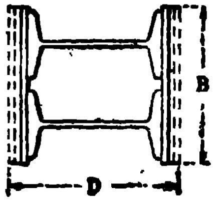


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	8	12	16	20	24	28	30	32	34	36	38	40	42	44
		HEIGHTS IN FEET.													
108 M	15 × 14	450	444	435	424	411	395	387	378	368	343	308	278	252	230
106 M	14½ × "	403	398	390	380	368	354	347	338	330	306	275	248	225	205
104 M	14 × "	357	352	345	336	326	313	306	299	291	263	241	217	197	180
103 M	13¾ × "	334	329	323	314	304	293	286	279	272	250	224	202	183	167
102 M	13½ × "	310	306	300	292	283	272	266	260	253	231	207	187	170	155
101 M	13¼ × "	287	283	278	270	262	251	246	240	234	212	190	172	156	142
100 M	13 × "	264	260	255	248	240	231	226	220	214	193	174	157	142	*129*
99 M	12¾ × "	241	237	233	226	219	210	205	200	195	175	157	142	128	*117*
94 M	14 × 12	282	277	270	260	249	235	225	198	175	156	140	127	*115*	*105*
93 M	13¾ × "	262	258	251	242	231	219	208	183	162	144	130	117	*106*	*96·8*
92 M	13½ × "	243	238	232	223	213	202	191	168	149	133	119	107	*97·6*	*88·9*
91 M	13¼ × "	223	219	213	205	196	185	174	153	136	121	108	98·0	*88·9*	*81·0*
90 M	13 × "	203	199	194	187	178	168	157	138	122	109	98·0	88·5	*80·2*	
89 M	12¾ × "	183	180	175	168	160	151	140	123	109	98·6	87·4	78·8	*71·5*	
78 M	13 × 14	442	436	428	417	404	389	381	372	362	339	304	275	249	*227*
76 M	12½ × "	395	390	383	373	361	348	340	332	324	302	271	244	*222*	*202*
74 M	12 × "	349	344	338	329	319	307	300	293	285	264	237	214	*194*	*177*
73 M	11¾ × "	326	321	315	307	297	286	280	273	266	245	220	*199*	*180*	*164*
72 M	11½ × "	303	298	293	285	276	265	260	253	247	227	203	*184*	*166*	*152*
71 M	11¼ × "	279	276	270	263	255	245	239	234	228	208	*187*	*168*	*153*	*139*
70 M	11 × "	256	253	248	241	233	224	219	214	208	189	*170*	*153*	*139*	*127*
69 M	10¾ × "	233	230	225	219	212	204	199	194	189	*170*	*153*	*138*	*125*	*114*

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

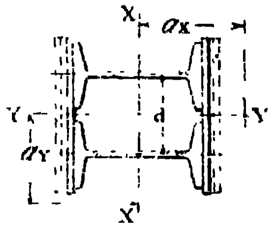
For other conditions and formulæ, see notes commencing page 192.

Safe loads printed in italics are for heights greater than 40D or B.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	d. Centres of Webs in inches.	Radii of Gyration		Eccentricity coefficients.			
Two Steel Joists.	Plates, each flange to form.				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
12 × 6*b*	14 × 1½	233½	67·9	7	**3·93**	6·13	**2·68**	2·50	**1 + 0·46a_Y**	1 + 0·20a_X
"	" × 1¼	209½	60·9	"	**3·91**	5·97	**2·69**	2·48	**1 + 0·46a_Y**	1 + 0·21a_X
"	" × 1	185½	53·9	"	**3·90**	5·80	**2·71**	2·46	**1 + 0·46a_Y**	1 + 0·21a_X
"	" × ⅞	174	50·4	"	**3·89**	5·72	**2·72**	2·45	**1 + 0·47a_Y**	1 + 0·21a_X
"	" × ¾	162	46·9	"	**3·87**	5·62	**2·73**	2·44	**1 + 0·47a_Y**	1 + 0·22a_X
"	" × ⅝	150	43·4	"	**3·86**	5·53	**2·74**	2·44	**1 + 0·47a_Y**	1 + 0·22a_X
"	" × ½	140	39·9	"	**3·84**	5·43	**2·75**	2·43	**1 + 0·48a_Y**	1 + 0·22a_X
"	" × ⅜	126	36·4	"	**3·83**	5·32	**2·77**	2·13	**1 + 0·48a_Y**	1 + 0·23a_X
12 × 5	12 × 1	148	42·8	6	**3·33**	5·83	**2·71**	2·44	**1 + 0·54a_Y**	1 + 0·21a_X
"	" × ⅞	138	39·8	"	**3·32**	5·74	**2·72**	2·44	**1 + 0·54a_Y**	1 + 0·21a_X
"	" × ¾	127½	36·8	"	**3·31**	5·61	**2·73**	2·43	**1 + 0·55a_Y**	1 + 0·21a_X
"	" × ⅝	117½	33·8	"	**3·30**	5·51	**2·75**	2·43	**1 + 0·55a_Y**	1 + 0·22a_X
"	" × ½	107½	30·8	"	**3·28**	5·43	**2·76**	2·43	**1 + 0·56a_Y**	1 + 0·22a_X
"	" × ⅜	97	27·8	"	**3·26**	5·31	**2·79**	2·44	**1 + 0·56a_Y**	1 + 0·23a_X
10 × 6	14 × 1½	229½	66·7	7	**3·94**	5·22	**2·67**	2·55	**1 + 0·45a_Y**	1 + 0·24a_X
"	" × 1¼	205½	59·7	"	**3·92**	5·07	**2·68**	2·52	**1 + 0·46a_Y**	1 + 0·25a_X
"	" × 1	181½	52·7	"	**3·91**	4·91	**2·70**	2·49	**1 + 0·46a_Y**	1 + 0·25a_X
"	" × ⅞	170	49·2	"	**3·90**	4·83	**2·71**	2·48	**1 + 0·46a_Y**	1 + 0·25a_X
"	" × ¾	158	45·7	"	**3·89**	4·75	**2·71**	2·47	**1 + 0·46a_Y**	1 + 0·26a_X
"	" × ⅝	146	42·2	"	**3·87**	4·66	**2·73**	2·46	**1 + 0·47a_Y**	1 + 0·26a_X
"	" × ½	134	38·7	"	**3·86**	4·57	**2·74**	2·45	**1 + 0·47a_Y**	1 + 0·27a_X
"	" × ⅜	122	35·2	"	**3·84**	4·47	**2·76**	2·44	**1 + 0·48a_Y**	1 + 0·27a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We=actual eccentric load; K=relative eccentricity coefficient; Wc=equivalent concentric value; Wc=We×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y **and a_X respectively.**

For full explanations of tables, see notes commencing page 192.

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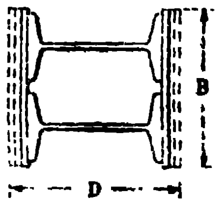


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat

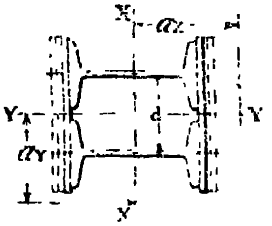
Reference Mark.	Size, D × B inches	HEIGHTS IN FEET.													
		8	12	16	20	22	24	26	28	30	32	34	36	38	40
64 M	12 × 12	275	270	262	253	248	242	236	229	220	193	171	153	137	124
63 M	11¾ × „	255	250	243	235	230	224	219	212	203	178	158	141	127	*114*
62 M	11½ × „	235	231	224	216	212	207	201	196	186	164	145	129	116	*105*
61 M	11¼ × „	215	211	205	198	191	189	184	177	169	149	132	118	*105*	*95·*
60 M	11 × „	195	192	186	180	176	171	167	162	152	134	118	106	*94·9*	*85·6*
59 M	10¾ × „	176	172	167	162	158	154	150	145	135	119	105	*93·9*	*84·3*	*76·0*
50 M	10 × 10	146	142	137	129	125	121	106	91·5	79·7	70·1	*62·1*	*55·4*		
49 M	9¾ × „	130	126	121	115	111	107	93·1	80·3	70·0	61·5	*54·5*	*48·6*		
38 M	11 × 14	415	409	401	391	386	379	372	365	357	349	340	319	*287*	*259*
36 M	10½ × „	368	363	356	347	342	337	330	324	317	309	302	*282*	*253*	*228*
34 M	10 × „	322	317	311	303	299	294	288	283	277	270	*263*	*244*	*219*	*198*
33 M	9¾ × „	299	294	289	281	277	273	268	262	256	250	*244*	*226*	*202*	*183*
32 M	9½ × „	275	271	266	259	255	251	246	241	236	*230*	*221*	*205*	*184*	*166*
31 M	9¼ × „	252	248	243	237	233	229	224	219	214	*209*	*201*	*179*	*161*	*145*
30 M	9 × „	229	225	220	214	211	207	202	198	193	*188*	*174*	*155*	*139*	*126*
29 M	8¾ × „	205	202	198	192	188	184	180	176	*172*	*167*	*149*	*133*	*119*	*108*
22 M	9½ × 12	227	223	217	210	205	200	195	190	182	*160*	*141*	*126*	*113*	*102*
21 M	9¼ × „	208	204	198	191	187	183	178	173	165	*145*	*128*	*114*	*103*	*92·7*
20 M	9 × „	188	184	179	173	169	165	161	156	148	*130*	*115*	*102*	*92·1*	*83·1*
19 M	8¾ × „	168	165	160	154	151	147	143	139	*131*	*115*	*103*	*90·8*	*81·5*	*73·6*
10 M	9 × 10	135	131	126	119	115	111	98·5	84·9	74·0	*65·0*	*57·6*	*51·4*		
9 M	8¾ × „	118	115	110	105	101	97·7	85·1	73·7	*64·3*	*56·4*	*49·9*	*44·5*		

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160
Safe loads are calculated by the Moncrieff Formula for stanchions of mild steel having "both ends flat."
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.
For other conditions and formulæ, see notes commencing page 192
Safe loads printed in italics are for heights greater than 40D
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	d. Centres of Webs in inches.	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Joists.	Plates, each flange to form				Axis Y – Y	Axis X – X	Web.	Flange.	Axis Y – Y	Axis X—X
10 × 5	12 × 1	144	41·6	6	3·34	4·95	2·71	2·47	1 + 0·54a_Y	1 + 0·25a_X
"	" × ⅞	134	38·6	"	3·33	4·86	2·72	2·46	1 + 0·54a_Y	1 + 0·25a_X
"	" × ¾	123½	35·6	"	3·32	4·77	2·73	2·45	1 + 0·54a_Y	1 + 0·25a_X
"	" × ⅝	113½	32·6	"	3·31	4·68	2·74	2·45	1 + 0·55a_Y	1 + 0·26a_X
"	" × ½	103½	29·6	"	3·29	4·58	2·76	2·44	1 + 0·55a_Y	1 + 0·26a_X
"	" × ⅜	93	26·6	"	3·28	4·47	2·78	2·44	1 + 0·56a_Y	1 + 0·27a_X
9 × 4	10 × ½	78½	22·3	5	2·75	4·16	3·10	2·44	1 + 0·66a_Y	1 + 0·29a_X
"	" × ⅜	70	19·8	"	2·73	4·06	3·13	2·45	1 + 0·67a_Y	1 + 0·30a_X
8 × 6	14 × 1½	215½	62·6	7	3·94	4·33	2·19	2·61	1 + 0·45a_Y	1 + 0·29a_X
"	" × 1¼	191½	55·6	"	3·93	4·18	2·20	2·57	1 + 0·45a_Y	1 + 0·30a_X
"	" × 1	167½	48·6	"	3·91	4·03	2·70	2·54	1 + 0·46a_Y	1 + 0·31a_X
"	" × ⅞	156	45·1	"	3·90	3·95	2·71	2·52	1 + 0·46a_Y	1 + 0·31a_X
"	" × ¾	144	41·6	"	3·89	3·87	2·72	2·51	1 + 0·46a_Y	1 + 0·32a_X
"	" × ⅝	132	38·1	"	3·88	3·79	2·73	2·49	1 + 0·47a_Y	1 + 0·32a_X
"	" × ½	120	34·6	"	3·86	3·70	2·74	2·48	1 + 0·47a_Y	1 + 0·33a_X
"	" × ⅜	108	31·1	"	3·84	3·61	2·76	2·47	1 + 0·48a_Y	1 + 0·34a_X
8 × 5	12 × ¾	119½	34·5	6	3·34	3·90	3·00	2·49	1 + 0·54a_Y	1 + 0·31a_X
"	" × ⅝	109½	31·5	"	3·33	3·81	3·02	2·47	1 + 0·54a_Y	1 + 0·32a_X
"	" × ½	99½	28·5	"	3·31	3·73	2·74	2·46	1 + 0·55a_Y	1 + 0·33a_X
"	" × ⅜	89	25·5	"	3·29	3·63	2·76	2·45	1 + 0·55a_Y	1 + 0·33a_X
8 × 4	10 × ½	72½	20·6	5	2·76	3·76	2·74	2·45	1 + 0·66a_Y	1 + 0·32a_X
"	" × ⅜	64	18·1	"	2·74	3·66	2·76	2·43	1 + 0·67a_Y	1 + 0·33a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c , to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load ; K = relative eccentricity coefficient ; Wc = equivalent concentric value. Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

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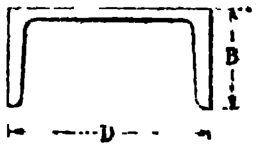


STANCHIONS.

Steel Channels.

Safe Concentric Loads, in Tons.
Ends Flat.

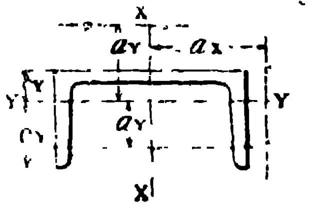
Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.												
		2	3	4	5	6	7	8	9	10	11	12	13	14
*27 N	15 × 4	81·9	81·0	79·7	78·1	76·1	73·8	71·2	68·2	61·8	51·1	42·9	36·0	*31·5*
26 N	12 × 4	71·2	70·5	69·5	68·2	66·6	64·7	62·6	60·2	57·6	48·0	40·3	34·3	*29·6*
*25 N	12 × 3½	64·0	63·1	61·9	60·2	58·3	56·0	53·3	46·8	37·9	31·3	*26·3*		
*24 N	12 × 3½	50·8	50·2	49·2	48·1	46·6	44·8	42·9	39·7	32·2	26·6	*22·3*	*19·0*	
23 N	11 × 4	64·9	64·3	63·4	62·2	60·8	59·2	57·2	55·1	52·8	45·0	37·8	32·2	*27·8*
22 N	11 × 3½	58·1	57·3	56·2	54·8	53·1	51·1	48·8	44·2	35·8	29·6	*24·9*	*21·2*	
21 N	10 × 4	58·9	58·4	57·6	56·6	55·4	53·9	52·2	50·3	48·3	42·2	35·5	30·2	*26·1*
*20 N	10 × 3½	55·0	54·2	53·2	51·9	50·4	48·5	46·4	43·0	34·8	28·8	*24·2*	*20·6*	
19 N	10 × 3½	45·9	45·3	44·5	43·5	42·2	40·8	39·1	37·2	30·6	25·3	*21·2*	*18·1*	
18 N	9 × 4	55·8	55·3	54·6	53·6	52·5	51·1	49·6	47·8	45·9	40·8	34·3	29·2	*25·2*
*17 N	9 × 3½	49·5	48·9	48·0	46·9	45·5	43·9	42·1	40·0	32·6	26·9	*22·6*	*19·3*	
*16 N	9 × 3½	43·4	42·9	42·2	41·2	40·0	38·7	37·1	35·4	29·6	24·4	*20·5*	*17·5*	
15 N	9 × 3	37·6	36·9	35·9	34·7	33·2	31·4	26·7	21·1	17·1	*14·1*			
14 N	8 × 4	50·3	49·9	49·2	48·4	47·4	46·2	44·8	43·3	41·7	37·9	31·9	27·1	*23·4*

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."
Safe loads for the conditions of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.
For other conditions and formulæ, see notes commencing page 192.
Safe loads printed in italics are for heights greater than 40B.
For explanations of properties, &c., see Part IV.

STANCHIONS.

Steel Channels.

Dimensions and Properties.



Size, D × B inches.	Weight per foot in lbs.	Area in square inches	Distance e_Y inches.	Radii of Gyration.		Eccentricity Coefficients.				
				Axis Y–Y	Axis X–X	Web.	Flange.	Axis Y–Y e_Y	Axis Y–Y c_Y	Axis X–X
*15 × 4	41·94	12·331	3·065	**1·08**	5·53	**1·74**	2·84	**$1 + 2\cdot60a_Y$**	$1 + 0\cdot79a_Y$	$1 + 0\cdot25a_X$
12 × 4	36·47	10·727	2·969	**1·13**	4·51	**1·84**	2·77	**$1 + 2\cdot34a_Y$**	$1 + 0\cdot81a_Y$	$1 + 0\cdot30a_X$
*12 × 3½	32·88	9·671	2·633	**0·96**	4·44	**1·82**	2·83	**$1 + 2\cdot86a_Y$**	$1 + 0\cdot94a_Y$	$1 + 0\cdot31a_X$
*12 × 3½	26·10	7·675	2·640	**0·99**	4·54	**1·75**	2·74	**$1 + 2\cdot68a_Y$**	$1 + 0\cdot87a_Y$	$1 + 0\cdot29a_X$
11 × 4	33·22	9·771	2·937	**1·14**	4·17	**1·86**	2·74	**$1 + 2\cdot24a_Y$**	$1 + 0\cdot81a_Y$	$1 + 0\cdot32a_X$
11 × 3½	29·82	8·771	2·604	**0·98**	4·11	**1·84**	2·79	**$1 + 2\cdot71a_Y$**	$1 + 0\cdot93a_Y$	$1 + 0\cdot33a_X$
10 × 4	30·16	8·871	2·898	**1·16**	3·84	**1·90**	2·70	**$1 + 2\cdot14a_Y$**	$1 + 0\cdot82a_Y$	$1 + 0\cdot34a_X$
*10 × 3½	28·21	8·296	2·567	**0·99**	3·77	**1·88**	2·76	**$1 + 2\cdot60a_Y$**	$1 + 0\cdot95a_Y$	$1 + 0\cdot35a_X$
10 × 3½	23·55	6·925	2·567	**1·02**	3·85	**1·84**	2·69	**$1 + 2\cdot47a_Y$**	$1 + 0\cdot90a_Y$	$1 + 0\cdot34a_X$
9 × 4	28·55	8·396	2·849	**1·17**	3·18	**1·96**	2·67	**$1 + 2\cdot06a_Y$**	$1 + 0\cdot83a_Y$	$1 + 0\cdot37a_X$
*9 × 3½	25·39	7·469	2·529	**1·01**	3·43	**1·92**	2·72	**$1 + 2\cdot47a_Y$**	$1 + 0\cdot95a_Y$	$1 + 0\cdot38a_X$
9 × 3½	22·27	6·550	2·524	**1·03**	3·19	**1·90**	2·66	**$1 + 2\cdot38a_Y$**	$1 + 0\cdot92a_Y$	$1 + 0\cdot37a_X$
9 × 3	19·37	5·696	2·246	**0·84**	3·38	**1·81**	2·77	**$1 + 3\cdot19a_Y$**	$1 + 1\cdot07a_Y$	$1 + 0\cdot40a_X$
8 × 4	25·73	7·569	2·799	**1·19**	3·12	**2·01**	2·64	**$1 + 1\cdot97a_Y$**	$1 + 0\cdot84a_Y$	$1 + 0\cdot41a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

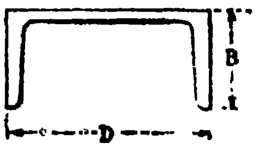
We = actual eccentric load; K = relative eccentricity coefficient, Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

Sections marked (*) are in our stocks.

For full explanations of tables, see notes commencing page 192.

For Stanchions in Buildings of Steel Skeleton Construction in London (see Part VI.)



STANCHIONS.

Steel Channels.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	11	12	13
*13 N	8 × 3½	44·3	43·8	43·0	42·0	40·8	39·4	37·8	36·1	30·0	24·8	*20·8*	*17·7*
12 N	8 × 3	37·5	36·8	35·9	34·8	33·4	31·8	28·7	22·7	18·4	*15·2*		
11 N	8 × 2½	29·2	28·4	27·4	26·1	24·5	19·8	15·1	*11·9*				
*10 N	7 × 3½	39·5	39·0	38·3	37·5	36·5	35·2	33·9	32·4	27·6	22·8	*19·2*	*16·3*
9 N	7 × 3	34·1	33·6	32·8	31·7	30·5	29·0	26·7	21·1	17·1	*14·1*		
8 N	6 × 3½	34·9	34·5	34·0	33·2	32·3	31·3	30·1	28·8	25·1	20·7	*17·4*	*14·8*
*7 N	6 × 3	31·7	31·1	30·4	29·5	28·4	27·0	25·4	20·0	16·2	*13·4*		
*6 N	6 × 3	28·2	27·7	27·1	26·3	25·3	24·2	22·9	18·4	14·9	*12·3*	*10·3*	
5 N	6 × 2½	23·2	22·7	21·9	20·8	19·6	16·3	12·5	*9·9*				
*4 N	5 × 2½	21·2	20·7	20·0	19·1	18·0	15·4	11·8	*9·3*				
*3 N	4 × 2	15·2	14·7	13·9	12·9	9·9	*7·3*	*5·6*					
2 N	3½ × 2	12·9	12·4	11·8	10·9	8·4	*6·2*						
*1 N	3 × 1½	9·8	9·1	7·8	5·0								

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 100.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

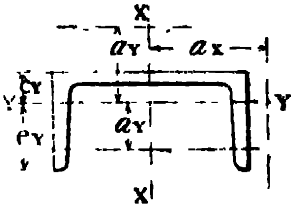
Safe loads printed in italics are for heights greater than 40B.

For explanations of properties, &c., see Part IV.

STANCHIONS.

Steel Channels.

Dimensions and Properties.



Size, D × B inches.	Weight per foot in lbs.	Area in square inches	Distance e_Y inches.	Radii of Gyration. Axis Y – Y	Radii of Gyration. Axis X – X	Eccentricity Coefficients. Web.	Eccentricity Coefficients. Flange	Eccentricity Coefficients. Axis Y—Y e_Y	Eccentricity Coefficients. Axis Y—Y c_Y	Eccentricity Coefficients. Axis X—X
*8 × 3½	22·72	6·682	2·489	**1·03**	3·09	**1·97**	2·68	**$1 + 2{\cdot}36a_Y$**	$1 + 0{\cdot}96a_Y$	$1 + 0{\cdot}42a_X$
8 × 3	19·30	5·675	2·156	**0·87**	3·07	**1·94**	2·70	**$1 + 2{\cdot}83a_Y$**	$1 + 1{\cdot}11a_Y$	$1 + 0{\cdot}43a_X$
8 × 2½	15·12	4·448	1·831	**0·71**	3·04	**1·87**	2·73	**$1 + 3{\cdot}58a_Y$**	$1 + 1{\cdot}30a_Y$	$1 + 0{\cdot}43a_X$
*7 × 3½	20·23	5·950	2·439	**1·04**	2·73	**2·03**	2·64	**$1 + 2{\cdot}24a_Y$**	$1 + 0{\cdot}97a_Y$	$1 + 0{\cdot}47a_X$
7 × 3	17·56	5·166	2·126	**0·88**	2·70	**1·98**	2·68	**$1 + 2{\cdot}74a_Y$**	$1 + 1{\cdot}13a_Y$	$1 + 0{\cdot}48a_X$
6 × 3½	17·90	5·266	2·381	**1·06**	2·37	**2·12**	2·60	**$1 + 2{\cdot}12a_Y$**	$1 + 1{\cdot}00a_Y$	$1 + 0{\cdot}53a_X$
*6 × 3	16·29	4·791	2·072	**0·89**	2·33	**2·08**	2·66	**$1 + 2{\cdot}60a_Y$**	$1 + 1{\cdot}17a_Y$	$1 + 0{\cdot}55a_X$
*6 × 3	14·49	4·261	2·062	**0·90**	2·37	**2·07**	2·60	**$1 + 2{\cdot}51a_Y$**	$1 + 1{\cdot}14a_Y$	$1 + 0{\cdot}53a_X$
6 × 2½	12·04	3·542	1·796	**0·73**	2·30	**1·93**	2·70	**$1 + 3{\cdot}38a_Y$**	$1 + 1{\cdot}33a_Y$	$1 + 0{\cdot}57a_X$
*5 × 2½	10·98	3·230	1·743	**0·74**	1·94	**2·05**	2·67	**$1 + 3{\cdot}18a_Y$**	$1 + 1{\cdot}38a_Y$	$1 + 0{\cdot}67a_X$
*4 × 2	7·96	2·341	1·344	**0·60**	1·56	**2·20**	2·64	**$1 + 3{\cdot}74a_Y$**	$1 + 1{\cdot}83a_Y$	$1 + 0{\cdot}82a_X$
3½ × 2	6·75	1·986	1·355	**0·60**	1·36	**2·16**	2·65	**$1 + 3{\cdot}78a_Y$**	$1 + 1{\cdot}80a_Y$	$1 + 0{\cdot}94a_X$
*3 × 1½	5·27	1·549	1·016	**0·43**	1·13	**2·23**	2·68	**$1 + 5{\cdot}32a_Y$**	$1 + 2{\cdot}54a_Y$	$1 + 1{\cdot}12a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

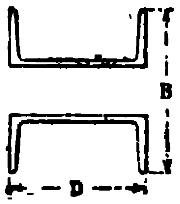
We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

Sections marked (*) are in our stocks.

For full explanations of tables, see notes commencing page 192.

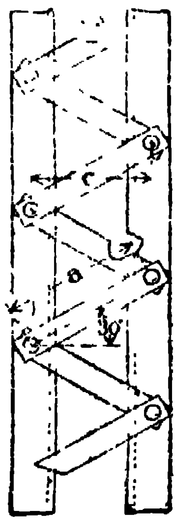
REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS.

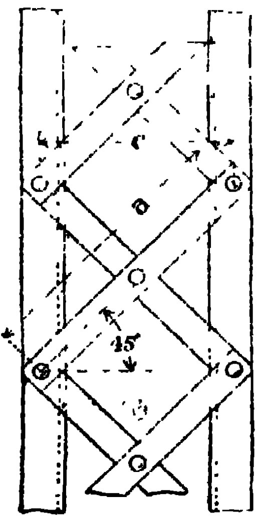
Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	12	16	18	20	22	24	26	28	30	32	34	36	40
25 O	12 × 13	128	126	124	123	121	119	117	115	113	111	108	105	101	81·6
20 O	10 × 12	110	108	105	104	102	100	98·3	96·1	93·7	91·3	88·0	*77·9*	*69·5*	*56·3*
17 O	9 × 11	98·4	96·3	93·4	91·6	89·6	87·5	85·1	82·6	79·8	69·5	*61·1*	*54·1*	*48·3*	*39·1*
13 O	8 × 10	87·5	85·0	81·5	79·4	77·1	74·5	71·8	61·8	*53·3*	*46·5*	*40·8*	*36·2*	*32·3*	
10 O	7 × 9	77·2	74·2	69·9	67·4	64·6	55·8	*46·9*	*40·0*	*34·5*	*30·0*				

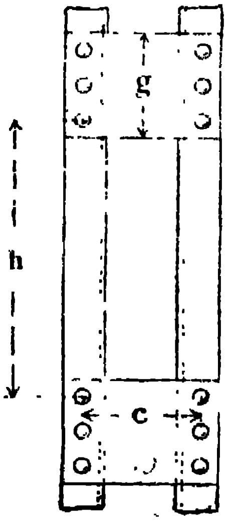


SINGLE LATTICING.

Suitable for values of *c*, not exceeding 15 inches.



DOUBLE LATTICING.

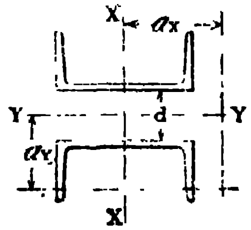


BATTEN PLATES.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat"
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line
For other conditions and formulæ, see notes commencing page 192.
Safe loads printed in italics are for heights greater than 40D.
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of Two Steel Channels Latticed.	Weight per foot in lbs.	Area in square inches.	d. Space between Webs. Inches.	Radii of Gyration.		Eccentricity Coefficients.			
				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
12 × 3½	66	19·3	6	**3·98**	4·44	**3·15**	2·83	**1 + 0·41a_Y**	1 + 0·31a_X
10 × 3½	56½	16·6	5	**3·57**	3·77	**3·22**	2·76	**1 + 0·47a_Y**	1 + 0·35a_X
9 × 3½	51	14·9	4	**3·14**	3·43	**3·35**	2·72	**1 + 0·56a_Y**	1 + 0·38a_X
8 × 3½	45½	13·3	3	**2·71**	3·09	**3·50**	2·68	**1 + 0·68a_Y**	1 + 0·42a_X
7 × 3½	40½	11·9	2	**2·31**	2·73	**3·66**	2·64	**1 + 0·84a_Y**	1 + 0·47a_X

CONVENTIONAL MAXIMUM SPACING AND MINIMUM PROPORTIONS OF LATTICE BARS AND BATTEN PLATES FOR CONCENTRIC LOADING (*Am. Ry Engineering and Maintenance of Way Assoc.*).

Depth of Channel, Inches.	12	10	9	8	7
Width of Lattice Bar, Inches.	2½	2½	2¼	2¼	2
Diameter of Rivet.	⅞	¾	¾	¾	⅝

SINGLE LATTICING—

Maximum angle of inclination with horizontal = 30 degrees
Minimum thickness = 1/40th of *a*, the diagonal centres of rivets.
Maximum horizontal centres of rivets, *c* = 15 inches

DOUBLE LATTICING—

Maximum angle of inclination with horizontal = 45 degrees
Minimum thickness = 1/60th of *a*, the diagonal centres of rivets.

BATTEN PLATES—

Maximum centres of end rivets of batten plates = *h* inches.
Let *l* = height of stanchion in inches, and *k* = radius of gyration of one channel

Then $h = \dfrac{l \times k \text{ least.}}{k \text{ greatest.}}$

Minimum thickness = 1/50th of *c*, the horizontal centres of rivets
Minimum width *g* = *c*, the horizontal centres of rivets for end plates.
" " *g* = ½*c*, " " " intermediate plates.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weights of lattices, base, &c., to be added.

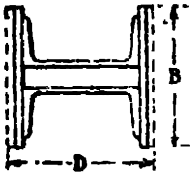
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load, K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark	Size, D × B inches.	HEIGHTS IN FEET. 8	12	16	20	22	24	26	28	30	32	34	36	38	40
58 P	15 × 14	406	400	391	380	373	366	359	350	342	333	307	274	246	222
56 P	14½ × "	359	354	346	336	330	323	316	309	301	293	265	237	212	192
54 P	14 × "	313	308	301	292	286	280	274	268	261	252	223	199	179	161
53 P	13¾ × "	290	285	278	269	264	259	253	247	240	228	202	180	162	146
52 P	13½ × "	266	262	256	247	243	237	232	226	220	205	181	162	145	131
51 P	13¼ × "	243	239	233	225	221	216	211	205	199	181	160	143	128	116
50 P	13 × "	220	216	210	205	199	194	189	184	178	157	139	124	111	101
49 P	12¾ × 12	185	180	173	164	158	153	133	115	100	88·2	78·1	69·7		
38 P	13 × 12	346	339	329	316	309	300	292	283	249	219	194	173	155	140
36 P	12½ × "	307	300	291	279	272	265	257	247	215	189	167	149	134	121
34 P	12 × "	267	261	253	242	236	229	222	208	181	159	141	126	113	102
33 P	11¾ × "	247	242	234	224	218	212	205	188	164	144	128	114	102	*92·3*
32 P	11½ × "	227	222	215	205	200	194	188	169	147	129	114	102	91·7	*82·7*
31 P	11¼ × "	207	202	195	187	181	176	170	149	130	114	101	90·4	*81·1*	
30 P	11 × "	188	183	176	168	163	158	150	130	113	99·4	88·0	78·5	*70·5*	
29 P	10¾ × 10	156	150	141	130	110	92·9	79·2	68·3	59·4					

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff **Formulæ for stanchions of mild steel having** "both ends flat."

Safe loads for the condition of "both ends **fixed" are identical with tabular loads on the** heights to left of zigzag line.

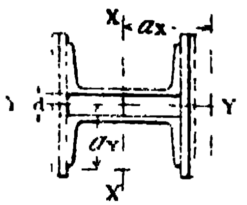
For other conditions and formulæ, **see notes commencing page 192.**

Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	d. Space between Webs in inches.	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Channels.	Plates, each flange to form.				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
12 × 3½	14 × 1½	211	61·3	3·5	3·69	6·12	2·16	2·50	$1+0{\cdot}52a_Y$	$1+0{\cdot}20a_X$
"	" × 1¼	187½	54·3	"	3·64	5·94	2·19	2·49	$1+0{\cdot}53a_Y$	$1+0{\cdot}21a_X$
"	" × 1	163½	47·3	"	3·58	5·75	2·23	2·48	$1+0{\cdot}55a_Y$	$1+0{\cdot}21a_X$
"	" × ⅞	150	43·8	"	3·54	5·64	2·26	2·48	$1+0{\cdot}56a_Y$	$1+0{\cdot}22a_X$
"	" × ¾	139½	40·3	"	3·49	5·53	2·29	2·49	$1+0{\cdot}57a_Y$	$1+0{\cdot}22a_X$
"	" × ⅝	128	36·8	"	3·44	5·41	2·33	2·50	$1+0{\cdot}59a_Y$	$1+0{\cdot}23a_X$
"	" × ½	116	33·3	"	3·37	5·28	2·39	2·52	$1+0{\cdot}62a_Y$	$1+0{\cdot}24a_X$
"	12 × ⅜	99	28·3	2·5	2·74	5·06	2·40	2·59	$1+0{\cdot}80a_Y$	$1+0{\cdot}25a_X$
10 × 3½	12 × 1½	181½	52·6	2·5	3·16	5·29	2·03	2·51	$1+0{\cdot}60a_Y$	$1+0{\cdot}23a_X$
"	" × 1¼	161	46·6	"	3·12	5·05	2·06	2·53	$1+0{\cdot}62a_Y$	$1+0{\cdot}25a_X$
"	" × 1	140½	40·6	"	3·07	4·87	2·10	2·52	$1+0{\cdot}64a_Y$	$1+0{\cdot}25a_X$
"	" × ⅞	130½	37·6	"	3·04	4·78	2·12	2·51	$1+0{\cdot}65a_Y$	$1+0{\cdot}26a_X$
"	" × ¾	120	34·6	"	3·00	4·68	2·15	2·51	$1+0{\cdot}67a_Y$	$1+0{\cdot}26a_X$
"	" × ⅝	110	31·6	"	2·95	4·57	2·19	2·52	$1+0{\cdot}69a_Y$	$1+0{\cdot}27a_X$
"	" × ½	99½	28·6	"	2·89	4·45	2·24	2·53	$1+0{\cdot}72a_Y$	$1+0{\cdot}28a_X$
"	10 × ⅜	84½	24·1	1·5	2·28	4·26	2·17	2·59	$1+0{\cdot}96a_Y$	$1+0{\cdot}30a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

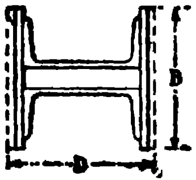
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load ; K = relative eccentricity coefficient ; Wc = equivalent concentric value ; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		8	12	14	16	18	20	22	24	26	28	30	32	34	36
24 P	11 × 12	256	251	247	243	238	233	227	221	214	204	178	156	138	123
23 P	10¾ × "	236	231	228	224	219	215	209	203	197	185	161	141	125	*112*
22 P	10½ × "	216	212	208	205	201	196	191	185	180	165	144	126	112	*100*
21 P	10¼ × "	197	192	189	186	182	177	173	168	162	146	127	112	99·0	*88·3*
20 P	10 × "	177	173	170	167	163	159	155	150	145	126	110	96·8	*85·7*	*76·4*
19 P	9¾ × 10	146	140	136	132	127	122	107	90·0	76·7	66·1	57·6			
14 P	10 × 10	218	211	206	201	195	189	182	164	140	120	105	92·3	*81·7*	
13 P	9¾ × "	201	195	191	186	180	174	168	148	126	109	95·1	83·6	*74·0*	
12 P	9½ × "	185	179	175	170	165	159	153	133	113	97·9	85·3	*74·9*		
11 P	9¼ × "	168	163	159	155	150	144	139	118	100	86·6	75·4	*66·3*		
10 P	9 × "	152	147	143	139	135	130	122	102	87·3	75·3	65·6	*57·6*		
9 P	8¾ × 9	130	123	119	115	110	95·9	79·2	66·6	56·7	48·9				

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

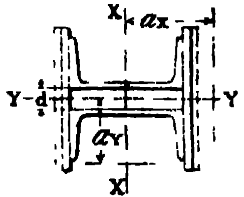
For other conditions and formulæ, see notes commencing page 192.

Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	d. Space between Webs in inches.	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Channels.	Plates, each flange to form.				Axis Y - Y	Axis X – X	Web.	Flange.	Axis Y—Y	Axis X—X
9 × 3½	12 × 1	135	38·9	2·5	**3·11**	4·47	**2·06**	2·52	**1 + 0·62a_Y**	1 + 0·28a_x
"	" × ⅞	124½	35·9	"	**3·08**	4·38	**2·08**	2·51	**1 + 0·63a_Y**	1 + 0·28a_x
"	" × ¾	114½	32·9	"	**3·04**	4·28	**2·10**	2·50	**1 + 0·65a_Y**	1 + 0·29a_x
"	" × ⅝	104½	29 9	"	**3·00**	4·18	**2·14**	2·50	**1 + 0·67a_Y**	1 + 0·30a_x
"	" × ½	94	26·9	"	**2·94**	4·07	**2·18**	2·51	**1 + 0·70a_Y**	1 + 0·30a_x
"	10 × ⅜	79	22·4	1·5	**2·33**	3·90	**2·11**	2·57	**1 + 0·92a_Y**	1 + 0·32a_x
8 × 3½	10 × 1	116	33·3	1·5	**2·58**	4·00	**1·88**	2·56	**1 + 0·75a_Y**	1 + 0·31a_x
"	" × ⅞	107½	30·8	"	**2·55**	3·91	**1·90**	2·55	**1 + 0·77a_Y**	1 + 0·32a_x
"	" × ¾	99	28·3	"	**2·52**	3·82	**1·93**	2·54	**1 + 0·79a_Y**	1 + 0·33a_x
"	" × ⅝	90½	25·8	"	**2·48**	3·73	**1·95**	2·54	**1 + 0·81a_Y**	1 + 0·33a_x
"	" × ½	82	23·3	"	**2·44**	3·63	**1·99**	2 54	**1 + 0·84a_Y**	1 + 0·34a_x
"	9 × ⅜	71	20·1	1	**2·12**	3·49	**1·93**	2·57	**1 + 1·01a_Y**	1 + 0·36a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_x respectively.

For full explanations of tables, see notes commencing page 192.

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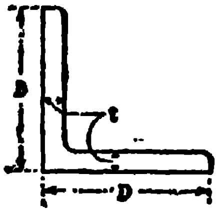


STANCHIONS (or STRUTS).
Steel Equal Angles.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B × t inches.	HEIGHTS IN FEET.												
		2	3	4	5	6	7	8	9	10	11	12	13	14
14*g* Q	6 × 6 × ¾	56·1	55·6	54·8	53·9	52·7	51·3	49·8	48·0	46·1	40·6	34·1	29·1	25·0
14*f* Q	" × ⅝	47·3	46·8	46·2	45·4	44·5	43·3	42·0	40·6	39·0	34·8	29 2	24·9	21·5
14*e* Q	" × ½	38·2	37·9	37·4	36·7	36·0	35·0	34·0	32·8	31·5	28·1	23·6	20·1	17·4
13*g* Q	5 × 5 × ¾	45·9	45·3	44·4	43·2	41·8	40·1	38·3	33·5	27·2	22·5	18·9		
13*f* Q	" × ⅝	38·8	38·3	37·6	36·6	35·5	34·1	32·6	29·5	23·9	19·8	16·6	14·1	
13*e* Q	" × ½	31·5	31·0	30·4	29·7	28·7	27·7	26·4	23·9	19·4	16·0	13·5	11·5	
12*g* Q	4½ × 4½ × ¾	40·8	40·1	39·1	37·8	36·2	34·3	29·7	23·5	19·0	15·7			
12*f* Q	" × ⅝	34·6	34·0	33·2	32·1	30·8	29·3	26·3	20·8	16·8	13·9			
12*e* Q	" × ½	28·1	27·6	26·9	26·0	25·0	23·8	21·4	16·9	13·7	11·3			
11*g* Q	4 × 4 × ¾	35·7	34·9	33·7	32·3	30·5	26·5	20·3	16·0	13·0				
11*f* Q	" × ⅝	30·3	29·6	28·7	27·5	26·1	23·7	18·1	14·3	11·6				
11*e* Q	" × ½	24·7	24·1	23·4	22·4	21·2	19·3	14·8	11·7	9·4				
11*d* Q	" × ⅜	18·8	18·4	17·8	17·1	16·2	15·1	11·5	9·1	7·4				
10*f* Q	3½ × 3½ × ⅝	26·1	25·3	24·3	23·0	21·4	16·0	12·2	9·7					
10*e* Q	" × ½	21·3	20·7	19·8	18·8	17·5	13·0	10·0	7·9					
10*d* Q	" × ⅜	16·3	15·8	15·2	14·3	13·4	10·0	7·6	6·0					

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

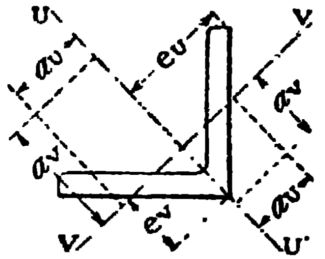
For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

STANCHIONS (or STRUTS).

Steel Equal Angles.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches	Distances in inches		Radii of Gyration.		Eccentricity Coefficients.	
			e_v	e_u	Axis V—V	Axis U—U	Axis V—V	Axis U—U
6 × 6 × ¾	28·70	8·441	2·49	4·24	**1·17**	2·28	**1 + 1·82a_v**	1 + 0·82a_u
" × ⅝	24·18	7·113	2·42	4·24	**1·18**	2·30	**1 + 1·74a_v**	1 + 0·81a_u
" × ½	19·55	5·753	2·35	4·24	**1·18**	2·32	**1 + 1·69a_v**	1 + 0·79a_u
5 × 5 × ¾	23·59	6·939	2·14	3·54	**0·96**	1·88	**1 + 2·32a_v**	1 + 1·00a_u
" × ⅝	19·92	5·860	2·07	3·54	**0·98**	1·89	**1 + 2·16a_v**	1 + 0·98a_u
" × ½	16·15	4·751	2·00	3·54	**0·98**	1·92	**1 + 2·09a_v**	1 + 0·96a_u
4½ × 4½ × ¾	21·05	6·189	1·96	3·18	**0·85**	1·69	**1 + 2·72a_v**	1 + 1·12a_u
" × ⅝	17·80	5·236	1·90	3·18	**0·87**	1·70	**1 + 2·51a_v**	1 + 1·10a_u
" × ½	14·46	4·252	1·83	3·18	**0·87**	1·72	**1 + 2·42a_v**	1 + 1·07a_u
4 × 4 × ¾	18·49	5·437	1·79	2·83	**0·76**	1·48	**1 + 3·10a_v**	1 + 1·28a_u
" × ⅝	15·66	4·609	1·72	2·83	**0·77**	1·50	**1 + 2·91a_v**	1 + 1·26a_u
" × ½	12·75	3·750	1·66	2·83	**0·77**	1·52	**1 + 2·80a_v**	1 + 1·22a_u
" × ⅜	9·72	2·859	1·59	2·83	**0·78**	1·54	**1 + 2·61a_v**	1 + 1·19a_u
3½ × 3½ × ⅝	13·55	3·985	1·55	2·47	**0·68**	1·29	**1 + 3·35a_v**	1 + 1·47a_u
" × ½	11·05	3·251	1·48	2·47	**0·68**	1·32	**1 + 3·21a_v**	1 + 1·43a_u
" × ⅜	8·45	2·485	1·41	2·47	**0·68**	1·34	**1 + 3·06a_v**	1 + 1·38a_u

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables, see notes commencing page 192.

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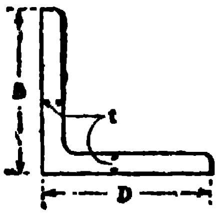


STANCHIONS (or STRUTS).

Steel Equal Angles.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B × t inches.	HEIGHTS IN FEET.							
		2	3	4	5	6	7	—	—
9*f* Q	3 ×3 × ⅝	21·8	21·0	19·8	18·3	13·3	9·8	—	—
9*e* Q	" × ½	17·9	17·2	16·2	15·0	10·9	8·0	—	—
9*d* Q	" × ⅜	13·7	13·2	12·4	11·5	8·4	6·1	—	—
9*c* Q	" × 5/16	11·5	11·1	10·4	9·6	7·0	5·2	—	—
9*b* Q	" × ¼	9·3	9·0	8·5	7·9	5·9	4·3	—	—
7*e* Q	2½×2½× ½	14·4	13·5	12·4	8·8	6·1		—	—
7*d* Q	" × ⅜	11·1	10·4	9·5	6·8	4·7		—	—
7*c* Q	" × 5/16	9·3	8·8	8·0	5·7	4·0		—	—
7*b* Q	" × ¼	7·6	7·1	6·5	4·6	3·2		—	—
6*c* Q	2¼×2¼× 5/16	8·3	7·7	6·4	4·1			—	—
6*b* Q	" × ¼	6·7	6·2	5·2	3·3			—	—
5*b* Q	2 ×2 × ¼	5·9	5·3	3·8	2·4			—	—
5*a* Q	" × 3/16	4·5	4·1	2·9	1·8			—	—

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

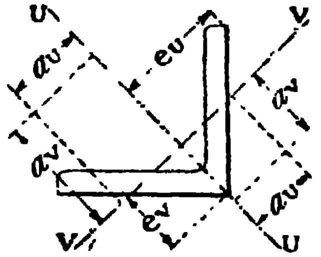
For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

STANCHIONS (or STRUTS).

Steel Equal Angles.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Distances in inches.		Radii of Gyration.		Eccentricity Coefficients	
			e_v	e_u	Axis V—V	Axis U—U	Axis V—V	Axis U—U
3 × 3 × $\frac{5}{8}$	11·43	3·362	1·37	2·12	**0·58**	1·09	$1+4{\cdot}07a_v$	$1+1{\cdot}76a_u$
" × $\frac{1}{2}$	9·36	2·753	1·31	2·12	**0·58**	1·12	$1+3{\cdot}89a_v$	$1+1{\cdot}70a_u$
" × $\frac{3}{8}$	7·18	2·112	1·24	2·12	**0·58**	1·13	$1+3{\cdot}69a_v$	$1+1{\cdot}64a_u$
" × $\frac{5}{16}$	6·05	1·776	1·21	2·12	**0·58**	1·15	$1+3{\cdot}60a_v$	$1+1{\cdot}61a_u$
" × $\frac{1}{4}$	4·90	1·440	1·17	2·12	**0·59**	1·15	$1+3{\cdot}37a_v$	$1+1{\cdot}60a_u$
2½ × 2½ × $\frac{1}{2}$	7·65	2·250	1·13	1·77	**0·48**	0·91	$1+4{\cdot}90a_v$	$1+2{\cdot}12a_u$
" × $\frac{3}{8}$	5·89	1·734	1·06	1·77	**0·48**	0·93	$1+4{\cdot}62a_v$	$1+2{\cdot}02a_u$
" × $\frac{5}{16}$	4·96	1·460	1·03	1·77	**0·48**	0·94	$1+4{\cdot}49a_v$	$1+1{\cdot}97a_u$
" × $\frac{1}{4}$	4·04	1·187	0·99	1·77	**0·48**	0·95	$1+4{\cdot}32a_v$	$1+1{\cdot}94a_u$
2¼ × 2¼ × $\frac{5}{16}$	4·45	1·310	0·94	1·59	**0·43**	0·84	$1+5{\cdot}11a_v$	$1+2{\cdot}22a_u$
" × $\frac{1}{4}$	3·61	1·061	0·91	1·59	**0·44**	0·85	$1+4{\cdot}72a_v$	$1+2{\cdot}20a_u$
2 × 2 × $\frac{1}{4}$	3·19	0·940	0·82	1·41	**0·39**	0·74	$1+5{\cdot}39a_v$	$1+2{\cdot}56a_u$
" × $\frac{3}{16}$	2·43	0·720	0·78	1·41	**0·39**	0·75	$1+5{\cdot}12a_v$	$1+2{\cdot}49a_u$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables, see notes commencing page 192.

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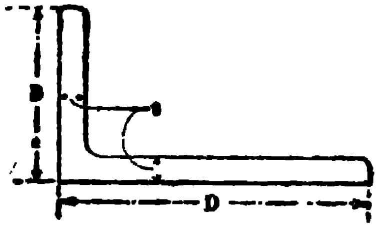

STANCHIONS (or STRUTS).
Steel Unequal Angles.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B × t inches.	HEIGHTS IN FEET.									
		2	3	4	5	6	7	8	9	10	11
25*g* R	7 × 3½ × ¾	48·0	46·8	45·2	43·1	40·6	33·8	25·9	20·4		
25*f* R	" × ⅝	40·5	39·6	38·2	36·5	34·4	29·3	22·4	17·7		
25*e* R	" × ½	32·8	32·1	31·0	29·6	27·9	23·7	18·2	14·4		
21*f* R	6 × 4 × ⅝	38·7	38·0	37·1	35·8	34·3	32·6	28·8	22·7	18·4	15·2
21*e* R	" × ½	31·4	30·8	30·0	29·0	27·8	26·4	23·3	18·4	14·9	12·3
20*f* R	6 × 3½ × ⅝	36·5	35·6	34·4	32·9	31·1	27·1	20·7	16·4	13·3	
20*e* R	" × ½	29·6	28·9	27·9	26·7	25·2	22·0	16·8	13·3	10·7	
20*d* R	" × ⅜	22·5	22·0	21·3	20·4	19·3	17·2	13·1	10·4	8·4	
63*f* R	6 × 3 × ⅝	34·1	33·0	31·4	29·4	24·5	18·0	13·8			
63*e* R	" × ½	27·7	26·8	25·5	23·9	19·9	14·6	11·2			
63*d* R	" × ⅜	21·1	20·4	19·5	18·3	15·6	11·5	8·8			

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

STANCHIONS (or STRUTS).

Steel Unequal Angles.

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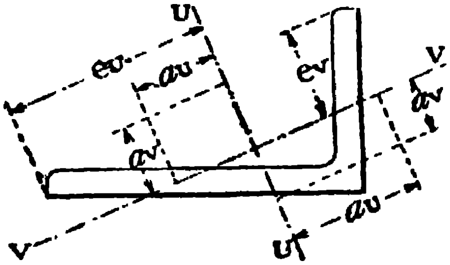
Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Distances in inches		Radii of Gyration.		Eccentricity Coefficients.	
			e_v	e_u	Axis V—V	Axis U—U	Axis V—V	Axis U—U
7 × 3½ × ¾	24·86	7·313	2·03	4·48	**0·73**	2·27	**1 + 3·81a_v**	1 + 0·87a_u
" × ⅝	20·98	6·172	2·05	4·51	**0·74**	2·29	**1 + 3·75a_v**	1 + 0·86a_u
" × ½	17·00	5·000	2·07	4·55	**0·74**	2·31	**1 + 3·78a_v**	1 + 0·86a_u
6 × 4 × ⅝	19·92	5·860	2·08	4·06	**0·86**	2·01	**1 + 2·82a_v**	1 + 1·00a_u
" × ½	16·15	4·750	2·08	4·09	**0·86**	2·03	**1 + 2·82a_v**	1 + 0·99a_u
6 × 3½ × ⅝	18·87	5·550	1·94	3·96	**0·74**	1·98	**1 + 3·49a_v**	1 + 1·01a_u
" × ½	15·31	4·502	1·92	3·99	**0·75**	2·00	**1 + 3·42a_v**	1 + 1·00a_u
" × ⅜	11·64	3·424	1·96	4·02	**0·76**	2·01	**1 + 3·39a_v**	1 + 1·00a_u
6 × 3 × ⅝	17·80	5·236	1·76	3·84	**0·63**	1·94	**1 + 4·43a_v**	1 + 1·02a_u
" × ½	14·46	4·252	1·76	3·88	**0·63**	1·96	**1 + 4·46a_v**	1 + 1·01a_u
" × ⅜	11·00	3·236	1·80	3·91	**0·64**	1·98	**1 + 4·38a_v**	1 + 1·00a_u

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In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

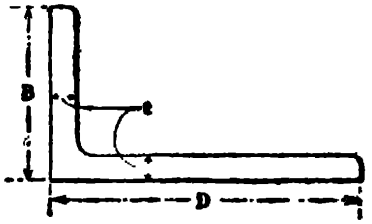
Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables, see notes commencing page 192.



STANCHIONS (or STRUTS).

Steel Unequal Angles.

Safe Concentric Loads, in Tons.

Ends Flat.

Reference Mark.	Size, D × B × t inches.	HEIGHTS IN FEET.									
		2	3	4	5	6	7	8	9	10	11
17*f* R	5 × 4 × ⅝	34·5	33·9	33·0	31·8	30·4	28·7	23·9	18·9	15·3	12·7
17*e* R	" × ½	28·0	27·5	26·8	25·9	24·7	23·4	19·9	15·7	12·7	10·5
17*d* R	" × ⅜	21·3	21·0	20·4	19·7	18·9	17·9	15·5	12·3	9·9	8·2
15*f* R	5 × 3 × ⅝	30·1	29·1	27·8	26·1	22·3	16·4	12·5			
15*e* R	" × ½	24·5	23·7	22·6	21·2	18·1	13·3	10·2			
15*d* R	" × ⅜	18·7	18·1	17·3	16·2	14·3	10·5	8·0			
11*e* R	4 × 3 × ½	21·2	20·5	19·5	18·3	15·2	11·2	8·6			
11*d* R	" × ⅜	16·2	15·7	15·0	14·0	12·0	8·8	6·7			
7*d* R	3 × 2½ × ⅜	12·4	11·7	10·9	8·8	6·1					
7*c* R	" × 5/16	10·4	9·9	9·2	7·4	5·2					

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

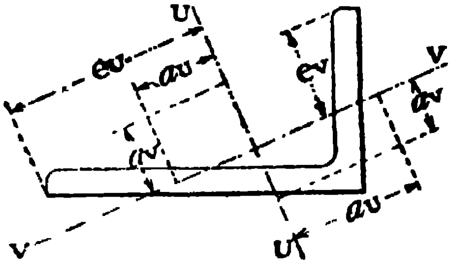
For other conditions and formulæ, see notes commencing page 192.

For explanations of properties, &c., see Part IV.

STANCHIONS (or STRUTS).

Steel Unequal Angles.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Distances in inches.		Radii of Gyration.		Eccentricity Coefficients.	
			e_v	e_u	Axis V—V	Axis U—U	Axis V—V	Axis U—U
5×4 × ⅝	17·80	5·236	1·81	3·46	**0·83**	1·74	**$1+2{\cdot}63a_v$**	$1+1{\cdot}15a_u$
" × ½	14·46	4·252	1·83	3·48	**0·84**	1·75	**$1+2{\cdot}60a_v$**	$1+1{\cdot}13a_u$
" × ⅜	11·00	3·236	1·82	3·49	**0·85**	1·77	**$1+2{\cdot}52a_v$**	$1+1{\cdot}12a_u$
5×3 × ⅝	15·67	4·609	1·65	3·30	**0·64**	1·64	**$1+4{\cdot}05a_v$**	$1+1{\cdot}23a_u$
" × ½	12·75	3·749	1·65	3·32	**0·64**	1·66	**$1+4{\cdot}02a_v$**	$1+1{\cdot}21a_u$
" × ⅜	9·72	2·859	1·67	3·36	**0·65**	1·67	**$1+3{\cdot}95a_v$**	$1+1{\cdot}20a_u$
4×3 × ½	11·05	3·251	1·45	2·75	**0·63**	1·36	**$1+3{\cdot}66a_v$**	$1+1{\cdot}48a_u$
" × ⅜	8·45	2·485	1·45	2·77	**0·64**	1·38	**$1+3{\cdot}54a_v$**	$1+1{\cdot}45a_u$
3×2½× ⅜	6·53	1·921	1·11	2·09	**0·52**	1·05	**$1+4{\cdot}10a_v$**	$1+1{\cdot}90a_u$
" × 5/16	5·51	1·620	1·10	2·10	**0·52**	1·06	**$1+4{\cdot}05a_v$**	$1+1{\cdot}87a_u$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We=actual eccentric load ; K=relative eccentricity coefficient ; Wc=equivalent concentric value ; Wc=We×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables, see notes commencing page 192.

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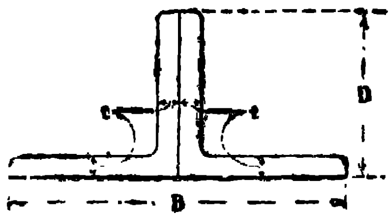


COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.														
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
14*g* S	6 × 12	113	112	111	111	110	109	107	106	104	102	100	98·2	95·9	93·4	90·9
14*f* S	"	95·0	94·6	94·1	93·4	92·6	91·7	90·6	89·4	88·0	86·4	84·8	83·0	81·0	79·0	76·8
14*e* S	"	76·8	76·5	76·1	75·6	74·9	74·2	73·3	72·3	71·2	70·0	68·7	67·2	65·7	64·1	62·3
13*g* S	5 × 10	92·5	91·9	91·2	90·2	89·1	87·7	86·1	84·3	82·3	80·1	77·7	75·2	67·3	58·7	51·6
13*f* S	"	78·1	77·7	77·1	76·3	75·3	74·1	72·8	71·3	69·7	67·8	65·9	63·8	58·0	50·5	44·4
13*e* S	"	63·3	63·0	62·5	61·9	61·1	60·2	59·1	57·9	56·6	55·1	53·6	51·9	47·8	41·6	36·6
12*g* S	4½ × 9	82·4	81·8	81·0	79·9	78·6	77·1	75·3	73·3	71·1	68·6	65·4	55·7	48·1	41·9	*36·8*
12*f* S	"	69·7	69·2	68·5	67·7	66·6	65·3	63·8	62·1	60·3	58·3	56·2	48·1	41·5	36·1	*31·7*
12*e* S	"	56·6	56·2	55·7	55·0	54·1	53·1	51·9	50·6	49·1	47·5	45·8	39·8	34·4	29·9	*26·3*
11*g* S	4 × 8	72·3	71·6	70·7	69·5	68·0	66·2	64·2	62·0	59·6	53·2	44·7	38·1	*32·8*	*28·6*	
11*f* S	"	61·3	60·7	60·0	58·9	57·7	56·3	54·6	52·8	50·7	46·2	38·8	33·1	*28·5*	*24·8*	
11*e* S	"	49·9	49·4	48·8	48·0	47·0	45·9	44·6	43·1	41·4	38·3	32·2	27·4	*23·6*	*20·6*	*18·1*
11*d* S	"	38·0	37·7	37·2	36·6	35·9	35·1	34·1	33·0	31·8	29·9	25·1	21·4	*18·5*	*16·1*	*14·1*
10*f* S	3½ × 7	52·8	52·2	51·3	50·2	48·8	47·1	45·2	43·2	36·3	30·0	*25·2*	*21·5*			
10*e* S	"	43·1	42·6	41·9	41·0	39·9	38·6	37·1	35·4	30·4	25·1	*21·1*	*18·0*			
10*d* S	"	33·0	32·6	32·1	31·4	30·5	29·6	28·5	27·2	23·8	19·7	*16·5*	*14·1*	*12·1*		

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192

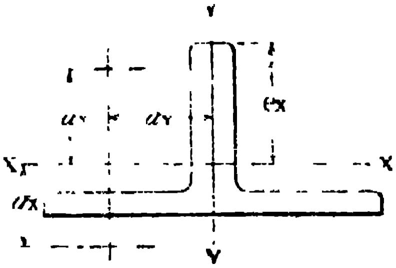
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Dimensions and Properties.



Composed of Two Equal Angles.	Weight per foot in lbs.	Area in square inches.	Distance C_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X–X	Axis Y—Y	Axis X—X
6 × 6 × ¾	59	16·88	4·24	2·53	**1·81**	$1+0{\cdot}94a_y$	$1+1{\cdot}29a_x$
" × ⅝	49½	14·22	4·29	2·50	**1·83**	$1+0{\cdot}96a_y$	$1+1{\cdot}28a_x$
" × ½	40½	11·50	4·34	2·48	**1·84**	$1+0{\cdot}98a_y$	$1+1{\cdot}28a_x$
5 × 5 × ¾	48½	13·87	3·49	2·12	**1·49**	$1+1{\cdot}11a_y$	$1+1{\cdot}56a_x$
" × ⅝	41	11·72	3·54	2·10	**1·51**	$1+1{\cdot}13a_y$	$1+1{\cdot}55a_x$
" × ½	33½	9·50	3·58	2·08	**1·52**	$1+1{\cdot}16a_y$	$1+1{\cdot}55a_x$
4½ × 4½ × ¾	43	12·38	3·11	1·92	**1·34**	$1+1{\cdot}21a_y$	$1+1{\cdot}74a_x$
" × ⅝	36¼	10·47	3·16	1·90	**1·35**	$1+1{\cdot}24a_y$	$1+1{\cdot}73a_x$
" × ½	29½	8·50	3·21	1·88	**1·36**	$1+1{\cdot}28a_y$	$1+1{\cdot}72a_x$
4 × 4 × ¾	38	10·87	2·74	1·73	**1·18**	$1+1{\cdot}34a_y$	$1+1{\cdot}97a_x$
" × ⅝	32	9·22	2·78	1·70	**1·19**	$1+1{\cdot}38a_y$	$1+1{\cdot}96a_x$
" × ½	26½	7·50	2·83	1·68	**1·20**	$1+1{\cdot}42a_y$	$1+1{\cdot}95a_x$
" × ⅜	20	5·72	2·88	1·66	**1·22**	$1+1{\cdot}46a_y$	$1+1{\cdot}93a_x$
3½ × 3½ × ⅝	28	7·97	2·41	1·50	**1·03**	$1+1{\cdot}55a_y$	$1+2{\cdot}25a_x$
" × ½	23	6·50	2·45	1·48	**1·05**	$1+1{\cdot}60a_y$	$1+2{\cdot}23a_x$
" × ⅜	17½	4·97	2·50	1·45	**1·06**	$1+1{\cdot}65a_y$	$1+2{\cdot}22a_x$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

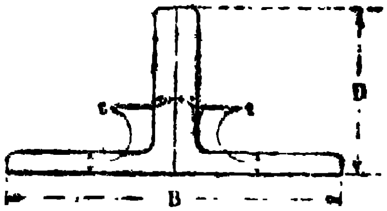
Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We=actual eccentric load; K=relative eccentricity coefficient; Wc=equivalent concentric value; Wc=We×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Safe Concentric Loads, in Tons. Ends Flat.

Reference Mark	Size, D × B inches	HEIGHTS IN FEET. 2	3	4	5	6	7	8	9	10	11	12
9*f* S	3 × 6	44·4	43·7	42·6	41·5	39·6	37·7	34·3	27·1	22·0	*18·2*	
9*e* S	"	36·4	35·8	35·0	33·9	32·6	31·1	29·0	22·9	18·5	*15·3*	
9*d* S		27·9	27·5	26·9	26·0	25·1	23·9	22·7	18·1	14·6	*12·1*	*10·1*
9*c* S		23·5	23·1	22·6	21·9	21·1	20·2	19·1	15·4	12·5	*10·3*	*8·6*
9*b* S	"	19·0	18·7	18·3	17·8	17·1	16·4	15·5	12·6	10·2	*8·5*	*7·1*
7*e* S	2½ × 5	29·5	28·8	27·8	26·5	25·0	20·8	16·0	*12·6*			
7*d* S	"	22·8	22·2	21·5	20·5	19·4	16·6	12·7	*10·0*			
7*c* S	"	19·2	18·7	18·1	17·3	16·4	14·2	10·9	*8·6*	*7·0*		
7*b* S	"	15·6	15·2	14·7	14·1	13·3	11·7	9·0	*7·1*	*5·7*		
6*c* S	2¼ × 4½	14·8	14·3	13·7	13·0	12·0	8·8	*6·7*				
6*b* S	"	13·9	13·5	12·9	12·2	11·1	8·5	*6·5*	*5·1*			
5*b* S	2 × 4	12·2	11·8	11·1	10·3	7·9	*5·8*					
5*a* S	"	9·4	9·0	8·5	7·9	6·1	*4·5*	*3·4*				

Rivets ¾-in. diam at 6 in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the conditions of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

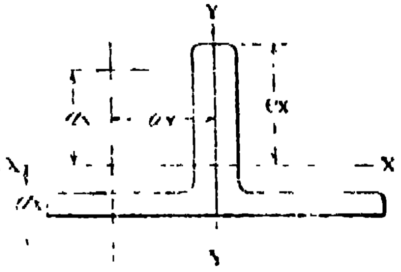
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Dimensions and Properties.



Composed of Two Equal Angles.	Weight per foot in lbs.	Area in square inches	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y-Y	Axis X-X	Axis Y-Y	Axis X-X
3 × 3 × ⅝	23½	6·72	2·03	1·30	**0·87**	$1+1{\cdot}76a_Y$	**$1+2{\cdot}64a_X$**
" × ½	19½	5·50	2·08	1·28	**0·89**	$1+1{\cdot}82a_Y$	**$1+2{\cdot}62a_X$**
" × ⅜	15	4·22	2·12	1·26	**0·90**	$1+1{\cdot}89a_Y$	**$1+2{\cdot}60a_X$**
" × $\frac{5}{16}$	13	3·55	2·15	1·24	**0·91**	$1+1{\cdot}93a_Y$	**$1+2{\cdot}60a_X$**
" × ¼	10½	2·88	2·17	1·23	**0·91**	$1+1{\cdot}97a_Y$	**$1+2{\cdot}60a_X$**
2½ × 2½ × ½	16	4·50	1·70	1·08	**0·73**	$1+2{\cdot}14a_Y$	**$1+3{\cdot}18a_X$**
" × ⅜	12½	3·47	1·75	1·06	**0·74**	$1+2{\cdot}24a_Y$	**$1+3{\cdot}16a_X$**
" × $\frac{5}{16}$	10½	2·92	1·77	1·04	**0·75**	$1+2{\cdot}29a_Y$	**$1+3{\cdot}15a_X$**
" × ¼	8½	2·37	1·80	1·03	**0·75**	$1+2{\cdot}35a_Y$	**$1+3{\cdot}15a_X$**
2¼ × 2¼ × $\frac{5}{16}$	9½	2·26	1·58	0·94	**0·67**	$1+2{\cdot}51a_Y$	**$1+3{\cdot}51a_X$**
" × ¼	7½	2·12	1·61	0·93	**0·68**	$1+2{\cdot}58a_Y$	**$1+3{\cdot}49a_X$**
2 × 2 × ¼	7	1·88	1·42	0·83	**0·59**	$1+2{\cdot}88a_Y$	**$1+3{\cdot}97a_X$**
" × $\frac{3}{16}$	5½	1·44	1·45	0·81	**0·60**	$1+3{\cdot}00a_Y$	**$1+4{\cdot}01a_X$**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

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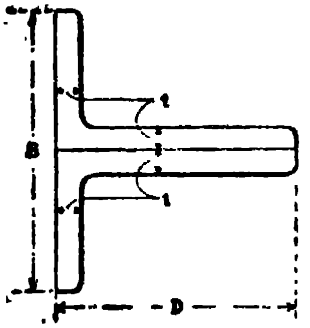


COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.														
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
25g T	7 × 7	97·3	96·5	95·4	93·9	92·1	90·0	87·6	84·9	81·9	78·7	67·1	57·2	49·3	43·0	37·8
25f T	"	82·1	81·4	80·4	79·1	77·6	75·7	73·6	71·2	68·6	64·7	54·3	46·3	39·9	34·8	30·5
25e T	"	66·5	65·9	65·0	64·0	62·7	61·1	59·3	57·3	55·1	50·4	42·4	36·1	31·1	27·1	
21f T	6 × 8	78·1	77·7	77·1	76·3	75·3	74·2	72·9	71·4	69·7	67·9	66·0	63·9	58·4	50·9	44·7
21e T	"	63·3	63·0	62·4	61·8	61·0	60·0	59·0	57·7	56·3	54·8	53·2	51·4	46·0	40·1	35·2
20f T	6 × 7	73·8	73·3	72·5	71·4	70·2	68·7	66·9	65·0	62·9	60·5	54·2	46·2	39·8	34·7	30·5
20e T	"	59·9	59·4	58·7	57·9	56·8	55·6	54·1	52·5	50·7	48·8	42·5	36·2	31·2	27·2	23·9
20d T	"	45·5	45·2	44·6	43·9	43·1	42·1	41·0	39·7	38·3	36·7	31·1	26·5	22·8	18·8	17·5
63f T	6 × 6	69·5	68·7	67·6	66·1	64·4	62·3	60·0	57·4	50·3	41·6	34·9	29·8	25·6		
63e T	"	56·4	55·7	54·8	53·6	52·1	50·3	48·3	46·1	39·0	32·2	27·1	23·1			
63d T	"	42·9	42·4	41·6	40·6	39·4	38·1	36·5	34·7	28·3	23·4	19·7	16·8			

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line

For other conditions and formulæ, see notes commencing page 192.

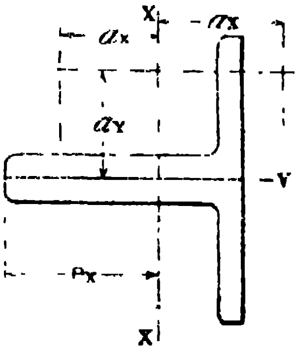
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Dimensions and Properties.



Composed of Two Unequal Angles.	Weight per foot in lbs	Area in square inches.	Distance e_x inches	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
7 × 3½ × ¾	51	14·62	4·40	**1·24**	2·21	**1 + 2·26a_y**	1 + 0·90a_x
" × ⅝	42½	12·31	4·45	**1·22**	2·22	**1 + 2·35a_y**	1 + 0·90a_x
" × ½	35½	10·00	4·50	**1·20**	2·24	**1 + 2·44a_y**	1 + 0·90a_x
6 × 4 × ⅝	41	11·72	3·98	**1·51**	1·88	**1 + 1·74a_y**	1 + 1·12a_x
" × ½	33½	9·50	4·03	**1·49**	1·90	**1 + 1·80a_y**	1 + 1·12a_x
6 × 3½ × ⅝	39	11·10	3·89	**1·28**	1·89	**1 + 2·12a_y**	1 + 1·09a_x
" × ½	32	9·00	3·94	**1·26**	1·91	**1 + 2·20a_y**	1 + 1·08a_x
" × ⅜	24½	6·85	3·99	**1·24**	1·91	**1 + 2·28a_y**	1 + 1·09a_x
6 × 3 × ⅝	37	10·47	3·78	**1·06**	1·89	**1 + 2·66a_y**	1 + 1·06a_x
" × ½	30½	8·50	3·83	**1·04**	1·91	**1 + 2·78a_y**	1 + 1·05a_x
" × ⅜	23½	6·47	3·88	**1·01**	1·92	**1 + 2·91a_y**	1 + 1·05a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load, K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192.

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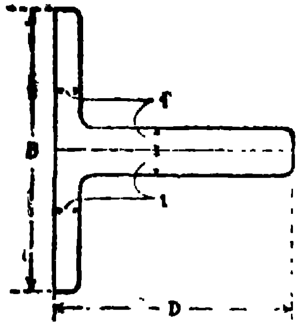


COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.														
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17*f* T	5 × 8	69·8	69·5	69·0	68·4	67·6	66·7	65·7	64·5	63·1	61·7	60·1	58·4	56·6	50·8	44·7
17*e* T	"	56·7	56·4	56·0	55·5	54·8	54·1	53·2	52·2	51·1	49·9	48·6	47·1	45·7	40·1	35·2
17*d* T	"	43·1	42·9	42·6	42·2	41·4	41·1	40·4	39·6	38·8	37·8	36·8	35·7	34·0	29·6	26·0
15*f* T	5 × 6	61·2	60·6	59·7	58·6	57·2	55·6	53·8	51·7	49·5	41·2	34·6	29·5	25·4	22·1	
15*e* T	"	49·8	49·3	48·5	47·6	46·4	45·0	43·5	41·7	38·9	32·1	27·0	23·0	19·8		
15*d* T	"	37·9	37·5	36·9	36·2	35·3	34·2	32·9	31·5	28·4	23·5	19·7	16·8	14·5		
11*e* T	4 × 6	43·2	42·8	42·3	41·5	40·7	39·6	38·4	37·1	35·7	32·0	26·9	22·9	*19·8*	*17·2*	
11*d* T	"	33·0	32·7	32·3	31·7	31·0	30·2	29·2	28·2	27·0	23·5	19·8	16·8	*14·5*	*12·6*	
7*d* T	3 × 5	25·5	25·1	24·7	24·1	23·4	22·5	21·6	20·4	16·5	*13·7*	*11·5*	*9·8*			
7*c* T	"	21·5	21·2	20·8	20·3	19·7	18·9	18·1	16·8	13·6	*11·3*	*9·5*	*8·1*			

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

Safe loads printed in italics are for heights greater than 40D.

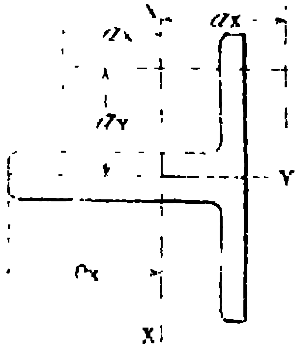
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Dimensions and Properties.



Composed of Two Unequal Angles.	Weight per foot in lbs.	Area in square inches	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
5 × 4 × ⅝	37	10·47	3·39	1·60	**1·54**	$1+1{\cdot}56a_Y$	**$1+1{\cdot}43a_x$**
" × ½	30½	8·50	3·44	1·58	**1·55**	$1+1{\cdot}61a_Y$	**$1+1{\cdot}43a_x$**
" × ⅜	23½	6·47	3·49	**1·55**	1·57	**$1+1{\cdot}65a_Y$**	$1+1{\cdot}42a_x$
5 × 3 × ⅝	32½	9·22	3·22	**1·13**	1·56	**$1+2{\cdot}36a_Y$**	$1+1{\cdot}32a_x$
" × ½	27	7·50	3·26	**1·10**	1·58	**$1+2{\cdot}46a_Y$**	$1+1{\cdot}31a_x$
" × ⅜	21	5·72	3·32	**1·08**	1·59	**$1+2{\cdot}57a_Y$**	$1+1{\cdot}31a_x$
4 × 3 × ½	23	6·50	2·68	**1·18**	1·24	**$1+2{\cdot}14a_Y$**	$1+1{\cdot}75a_x$
" × ⅜	17½	4·97	2·73	**1·16**	1·25	**$1+2{\cdot}23a_Y$**	$1+1{\cdot}75a_x$
3 × 2½ × ⅜	14	3·84	2·05	1·00	**0·92**	$1+2{\cdot}47a_Y$	**$1+2{\cdot}43a_x$**
" × $\frac{5}{16}$	12	3·24	2·08	0·99	**0·92**	$1+2{\cdot}53a_Y$	**$1+2{\cdot}37a_x$**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

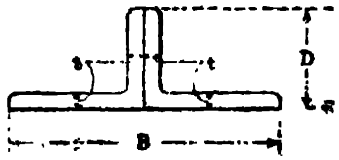
We = actual eccentric load, K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_x respectively.

For full explanations of tables, see notes commencing page 192.

For Stanchions in Buildings of Steel Skeleton Construction [illegible] (see Part VI.)

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.												
		2	3	4	5	6	7	8	9	10	11	12	13	14
25*g* U	3½ × 14	96·7	95·2	93·0	90·2	86·8	82·9	78·5	62·4	50·6	41·8	*35·1*		
25*f* U	"	81·6	80·4	78·6	76·3	73·5	70·3	66·6	54·0	43·7	36·2	*30·4*		
25*e* U	"	66·2	65·2	63·8	61·9	59·7	57·2	54·3	44·9	36·4	30·1	*25·3*		
21*f* U	4 × 12	77·8	77·0	75·9	74·5	72·7	70·6	68·3	65·6	62·6	51·7	43·5	37·0	*31·9*
21*e* U	"	63·1	62·5	61·6	60·5	59·1	57·4	55·5	53·4	51·1	42·8	36·0	30·7	*26·4*
20*f* U	3½ × 12	73·5	72·4	70·9	69·0	66·7	64·0	60·9	52·2	42·3	35·0	*29·4*		
20*e* U	"	59·6	58·8	57·6	56·1	54·2	52·1	49·6	43·5	35·2	29·1	*24·4*		
20*d* U	"	45·3	44·7	43·8	42·7	41·3	39·7	37·9	33·7	27·3	22·6	*19·0*		
63*f* U	3 × 12	68·9	67·4	65·3	62·6	59·4	54·3	41·6	32·8	26·6				
63*e* U	"	56·0	54·8	53·2	51·0	48·5	45·5	34·8	27·5	22·3				
63*d* U	"	42·6	41·8	40·5	39·0	37·1	34·9	27·2	21·5	17·4				

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

Safe loads printed in italics are for heights greater than 40D.

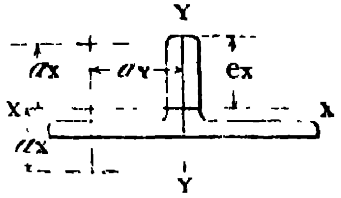
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Dimensions and Properties.



Composed of Two Unequal Angles.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
7 × 3½ × ¾	50½	14·62	2·64	3·41	**0·90**	$1+0{\cdot}60a_Y$	$\mathbf{1+3{\cdot}24a_X}$
" × ⅝	43	12·34	2·69	3·38	**0·91**	$1+0{\cdot}61a_Y$	$\mathbf{1+3{\cdot}22a_X}$
" × ½	35	10·00	2·74	3·35	**0·92**	$1+0{\cdot}62a_Y$	$\mathbf{1+3{\cdot}20a_X}$
6 × 4 × ⅝	40½	11·72	2·98	2·76	**1·12**	$1+0{\cdot}79a_Y$	$\mathbf{1+2{\cdot}37a_X}$
" × ½	33	9·50	3·03	2·73	**1·13**	$1+0{\cdot}81a_Y$	$\mathbf{1+2{\cdot}36a_X}$
6 × 3½ × ⅝	38½	11·10	2·63	2·83	**0·94**	$1+0{\cdot}75a_Y$	$\mathbf{1+2{\cdot}93a_X}$
" × ½	31½	9·00	2·68	2·81	**0·96**	$1+0{\cdot}76a_Y$	$\mathbf{1+2{\cdot}91a_X}$
" × ⅜	24	6·85	2·73	2·77	**0·97**	$1+0{\cdot}78a_Y$	$\mathbf{1+2{\cdot}90a_X}$
6 × 3 × ⅝	36½	10·47	2·27	2·92	**0·77**	$1+0{\cdot}71a_Y$	$\mathbf{1+3{\cdot}80a_X}$
" × ½	29½	8·50	2·32	2·89	**0·78**	$1+0{\cdot}72a_Y$	$\mathbf{1+3{\cdot}76a_X}$
" × ⅜	23	6·47	2·37	2·86	**0·79**	$1+0{\cdot}73a_Y$	$\mathbf{1+3{\cdot}74a_X}$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

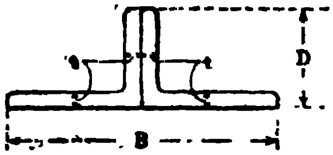
Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load ; K = relative eccentricity coefficient ; Wc = equivalent concentric value ; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.												
		2	3	4	5	6	7	8	9	10	11	12	13	14
17*f* U	4 × 10	69·6	68·9	68·0	66·8	65·3	63·5	61·5	59·3	56·9	49·2	41·4	35·3	*30·4*
17*e* U	"	56·5	56·0	55·2	54·3	53·1	51·7	50·1	48·4	46·4	40·9	34·4	29·3	*25·2*
17*d* U	"	43·0	42·6	42·1	41·3	40·5	39·4	38·2	36·9	35·5	31·8	26·7	22·7	*19·6*
15*f* U	3 × 10	60·7	59·5	57·8	55·6	53·0	50·0	39·9	31·5	25·5				
15*e* U	"	49·4	48·5	47·1	45·4	43·3	40·9	33·3	26·3	21·3				
15*d* U	"	37·7	37·0	36·0	34·7	33·2	31·4	26·2	20·7	16·7	*13·8*			
11*e* U	3 × 8	42·9	42·2	41·1	39·7	38·0	36·1	31·5	24·9	20·2	*16·7*			
11*d* U	"	32·8	32·3	31·5	30·4	29·2	27·8	24·8	19·6	15·9	*13·1*			
7*d* U	2½ × 6	25·2	24·6	23·7	22·6	21·3	17·6	13·5	*10·6*					
7*c* U	"	21·3	20·8	20·0	19·1	18·0	15·1	11·6	*9·1*					

Rivets ¾-in. diam. at 6-in.-pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

Safe loads printed in italics are for heights greater than 40D.

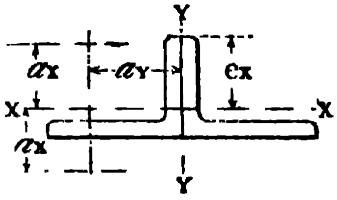
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Dimensions and Properties.



Composed of Two Unequal Angles.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
5 × 4 × ⅝	36½	10·47	2·89	2·22	**1·15**	1 + 1·01a_Y	**1 + 2·16a_X**
" × ½	29½	8·50	2·94	2·20	**1·17**	1 + 1·03a_Y	**1 + 2·15a_X**
" × ⅜	23	6·47	2·99	2·18	**1·18**	1 + 1·06a_Y	**1 + 2·14a_X**
5 × 3 × ⅝	32	9·22	2·21	2·37	**0·80**	1 + 0·89a_Y	**1 + 3·40a_X**
" × ½	26½	7·50	2·26	2·34	**0·82**	1 + 0·91a_Y	**1 + 2·99a_X**
" × ⅜	20	5·72	2·31	2·31	**0·83**	1 + 0·93a_Y	**1 + 2·97a_X**
4 × 3 × ½	23	6·50	2·18	1·80	**0·85**	1 + 1·23a_Y	**1 + 3·41a_X**
" × ⅜	17½	4·97	2·23	1·78	**0·86**	1 + 1·26a_Y	**1 + 3·40a_X**
3 × 2½ × ⅜	14	3·84	1·80	1·32	**0·72**	1 + 1·73a_Y	**1 + 3·37a_X**
" × 5/16	12	3·24	1·83	1·30	**0·73**	1 + 1·76a_Y	**1 + 3·35a_X**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

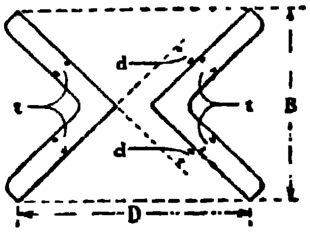
Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficients; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

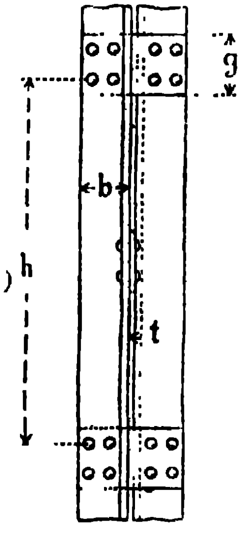


COMPOUND STANCHIONS (or STRUTS).

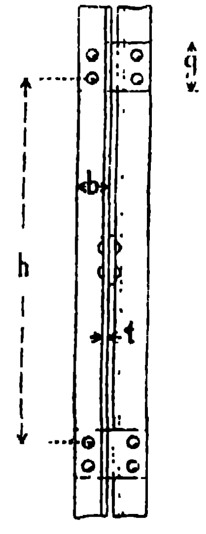
Two Steel Equal Angles Battened.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.														
		2	4	6	8	10	11	12	13	14	15	16	17	18	19	20
14*g* V	$10\frac{3}{8} \times 8\frac{1}{2}$	113	112	111	109	107	106	105	103	102	100	98·9	97·1	95·2	93·2	91·1
14*f* V	10 × „	95·1	94·5	93·6	92·3	90·6	89·7	88·6	87·4	86·2	84·9	83·4	82·0	80·4	78·7	77·0
14*e* V	$9\frac{11}{16}$ × „	76·9	76·5	75·7	74·7	73·4	72·6	71·8	70·9	69·9	68·8	67·7	66·5	65·3	63·9	62·6
13*g* V	$9 \times 7\frac{1}{8}$	92·6	91·8	90·5	88·6	86·2	84·8	83·3	81·6	79·8	77·9	76·0	72·6	64·7	58·1	52·5
13*f* V	$8\frac{5}{8}$ × „	78·2	77·6	76·5	74·9	72·9	71·7	70·4	69·0	67·6	66·0	64·3	62·0	55·3	49·6	44·8
13*e* V	$8\frac{1}{4}$ × „	63·4	62·9	62·0	60·8	59·2	58·3	57·2	56·1	55·0	53·7	52·4	51·0	45·9	41·2	37·1
12*g* V	$8\frac{5}{16} \times 6\frac{3}{8}$	82·6	81·7	80·2	78·1	75·4	73·9	72·2	70·4	68·4	66·4	58·7	52·0	46·4	41·6	37·6
12*f* V	$7\frac{11}{16}$ × „	69·9	69·1	67·9	66·1	63·9	62·6	61·2	59·7	58·1	56·3	50·3	44·6	39 7	35·7	32·2
12*e* V	$7\frac{9}{16}$ × „	56·7	56·1	55·2	53·8	52 0	51·0	49·9	48·7	47·4	46·0	41·9	37·1	33·1	29·7	26·8



For 6-in. and 5-in. angles.



For $4\frac{1}{2}$-in. to 2-in. angles.

The angles forming stanchions or struts of this class are usually secured together with batten plates spaced alternately at right angles to each other.

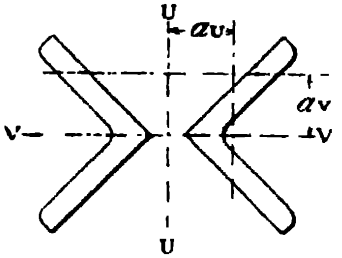
See opposite page for conventional spacing and proportions.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat"
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.
For other conditions and formulæ, see notes commencing page 192.
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Battened.

Dimensions and Properties.



Composed of Two Equal Angles.	Weight per foot in lbs.	Area in square inches.	Thickness of Batten Plates. Inch.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis V—V	Axis U—U	Axis V—V	Axis U—U
6 × 6 × ¾	57½	16·88	¾	**2·28**	3·23	**1+0·82a_V**	1+0·50a_U
" × ⅝	48½	14·22	⅝	**2·30**	3·09	**1+0·81a_V**	1+0·52a_U
" × ½	39½	11·50	½	**2·32**	2·95	**1+0·79a_V**	1+0·55a_U
5 × 5 × ¾	47½	13·87	¾	**1·88**	2·83	**1+1·00a_V**	1+0·56a_U
" × ⅝	40	11·72	⅝	**1·89**	2·69	**1+0·98a_V**	1+0·59a_U
" × ½	32½	9·50	½	**1·92**	2·55	**1+0·96a_V**	1+0·63a_U
4½ × 4½ × ¾	42½	12·38	¾	**1·69**	2·63	**1+1·12a_V**	1+0·60a_U
" × ⅝	36	10·47	⅝	**1·70**	2·49	**1+1·10a_V**	1+0·64a_U
" × ½	29	8·50	½	**1·72**	2·35	**1+1·07a_V**	1+0·69a_U

CONVENTIONAL MAXIMUM SPACING AND MINIMUM PROPORTIONS OF BATTEN PLATES FOR CONCENTRIC LOADING (*Am. Ry. Engineering and Maintenance of Way Assoc.*).

Maximum centres of end rivets of batten plates = *h* inches.

h = the lesser value of $\begin{cases}\text{10 times } b \text{ the width of one leg in inches.}\\ \text{60 times } t \text{ the angle thickness in inches.}\end{cases}$

Minimum width of batten plates = *g* inches.

g = the greater value of $\begin{cases} b \text{ the width of one leg, or } c \text{ the horizontal centres of rivets, or the}\\ \text{least width suitable for 2 rivets, in inches.}\end{cases}$

Rivet diameter = ⅞ inch for angles ¾, ⅝, ½, and ⅜ inch thick.

" " = ⅝ " " " 5/16 inch thick.

" " = ½ " " " ¼ and 3/16 inch thick.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

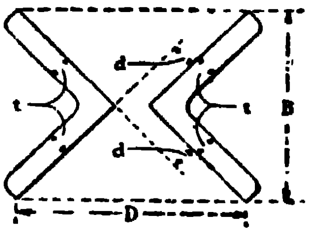
Each weight per foot is for the shaft only. Weight of batten plates, rivets, base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W=actual eccentric load; K=relative eccentricity coefficient; Wc=equivalent concentric value; Wc=W×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_V and a_U respectively.

For full explanation of tables, see notes commencing page 192.



COMPOUND STANÇHIONS (or STRUTS).

Two Steel Equal Angles Battened.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.													
		2	3	4	5	6	7	8	9	10	11	12	13	14	15
11*g* V	$7\frac{5}{8} \times 5\frac{11}{16}$	72·5	72·1	71·5	70·7	69·8	68·7	67·4	66·0	64·4	62·6	60·7	58·7	52·1	45·4
11*f* V	$7\frac{1}{4} \times$ „	61·4	61·1	60·6	60·0	59·2	58·3	57·2	56·0	54·7	53·3	51·7	50·0	45·1	39·3
11*e* V	$6\frac{7}{8} \times$ „	50·0	49·7	49·3	48·8	48·2	47·5	47·0	46·7	44·7	43·5	42·3	41·0	37·8	32·9
11*d* V	$6\frac{9}{16} \times$ „	38·1	37·9	37·6	37·2	36·8	36·3	35·6	34·9	34·1	33·3	32·4	31·4	29·4	25·6
10*f* V	$6\frac{9}{16} \times 5$	53·0	52·6	52·1	51·3	50·4	49·4	48·1	46·8	45·3	43·6	39·5	33·7	29·0	25·3
10*e* V	$6\frac{3}{16} \times$ „	43·3	43·0	42·5	41·9	41·2	40·4	39·4	38·3	37·1	35·8	33·3	28·4	24·5	21·3
10*d* V	$5\frac{7}{8} \times$ „	33·1	32·8	32·5	32·1	31·6	30·9	30·2	29·4	28·5	27·6	26·3	22·4	19·3	16·8
9*f* V	$5\frac{7}{8} \times 4\frac{1}{4}$	44·6	44·1	43·5	42·6	41·6	40·3	38·9	37·3	34·4	28·4	23·9	20·3	17·5	
9*e* V	$5\frac{1}{2} \times$ „	36·6	36·2	35·6	35·0	34·1	33·2	32·0	30·8	29·2	24·2	20·3	17·3	14·9	
9*d* V	$5\frac{3}{16} \times$ „	28·0	27·8	27·4	26·9	26·3	25·5	24·7	23·8	22·7	19·2	16·1	13·7	11·8	*10·3*
9*c* V	$5\frac{1}{16} \times$ „	23·6	23·4	23·0	22·6	22·1	21·5	20·8	20·0	19·2	16·4	13·8	11·8	10·1	*8·8*
9*b* V	$4\frac{13}{16} \times$ „	19·1	18·9	18·7	18·3	17·9	17·4	16·9	16·3	15·6	13·4	11·3	9·6	8·3	*7·2*
7*e* V	$4\frac{13}{16} \times 3\frac{9}{16}$	29·7	29·3	28·6	27·8	26·8	25·6	24·3	19·7	16·0	13·2	*11·1*			
7*d* V	$4\frac{7}{16} \times$ „	22·9	22·6	22·1	21·5	20·8	19·9	18·9	15·9	12·9	10·7	*9·0*			
7*c* V	$4\frac{3}{8} \times$ „	19·3	19·0	18·6	18·1	17 5	16·8	16·0	13·7	11·1	9·2	*7·7*			
7*b* V	$4\frac{1}{8} \times$ „	15·7	15·5	15·2	14·8	14·3	13·7	13·0	11·3	9·2	7·6	*6·4*			
6*c* V	$4\frac{1}{16} \times 3\frac{3}{16}$	14·9	14·6	14·3	13·8	13·2	12·5	10·8	8 5	6·9	*5·7*				
6*b* V	$3\frac{3}{4} \times$ „	14·0	13·7	13·4	12·9	12·4	11·8	10·2	8·1	6·5	*5·4*				
5*b* V	$3\frac{7}{16} \times 2\frac{7}{8}$	12·3	12·0	11·6	11·1	10·5	9·0	6·9	5·4						
5*a* V	$3\frac{5}{16} \times$ „	9·5	9·2	8·9	8·5	8·1	7·1	5·4	4·3	*3·5*					

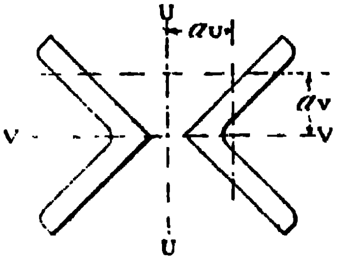
For sketch, see page 180.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."
Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.
For other conditions and formulæ, see notes commencing page 192.
Safe loads printed in italics are for heights greater than 40B.
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Battened.

Dimensions and Properties.



Composed of Two Equal Angles.	Weight per foot in lbs.	Area in square inches.	Thickness of Batten Plate. Inch.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis V—V	Axis U—U	Axis V—V	Axis U—U
4 × 4 × ¾	37	10·87	¾	**1·48**	2·44	**1 + 1·28a_v**	1 + 0·64a_u
" × ⅝	31½	9·22	⅝	**1·50**	2·29	**1 + 1·26a_v**	1 + 0·69a_u
" × ½	25½	7·50	½	**1·52**	2·15	**1 + 1·22a_v**	1 + 0·74a_u
" × ⅜	19½	5·72	⅜	**1·54**	2·01	**1 + 1·19a_v**	1 + 0·81a_u
3½ × 3½ × ⅝	27½	7·97	⅝	**1·29**	2·10	**1 + 1·47a_v**	1 + 0·74a_u
" × ½	22½	6·50	½	**1·31**	1·95	**1 + 1·43a_v**	1 + 0·81a_u
" × ⅜	17	4·97	⅜	**1·34**	1·81	**1 + 1·38a_v**	1 + 0·89a_u
3 × 3 × ⅝	23	6·72	⅝	**1·09**	1·90	**1 + 1·76a_v**	1 + 0·81a_u
" × ½	19	5·50	½	**1·12**	1·76	**1 + 1·70a_v**	1 + 0·89a_u
" × ⅜	14½	4·22	⅜	**1·13**	1·61	**1 + 1·64a_v**	1 + 0·99a_u
" × 5/16	12½	3·55	⅜	**1·15**	1·58	**1 + 1·61a_v**	1 + 1·01a_u
" × ¼	10	2·88	¼	**1·15**	1·47	**1 + 1·60a_v**	1 + 1·11a_u
2½ × 2½ × ½	15½	4·50	½	**0·91**	1·56	**1 + 2·12a_v**	1 + 0·99a_u
" × ⅜	12	3·47	⅜	**0·93**	1·41	**1 + 2·02a_v**	1 + 1·11a_u
" × 5/16	10	2·92	⅜	**0·94**	1·38	**1 + 1·97a_v**	1 + 1·14a_u
" × ¼	8½	2·37	¼	**0·95**	1·26	**1 + 1·94a_v**	1 + 1·28a_u
2¼ × 2¼ × 5/16	9	2·26	⅜	**0·84**	1·28	**1 + 2·22a_v**	1 + 1·22a_u
" × ¼	7½	2·12	¼	**0·85**	1·17	**1 + 2·20a_v**	1 + 1·37a_u
2 × 2 × ¼	6½	1·88	¼	**0·74**	1·07	**1 + 2·56a_v**	1 + 1·48a_u
" × 3/16	5	1·44	¼	**0·75**	1·03	**1 + 2·49a_v**	1 + 1·54a_u

For conventional spacing and proportions, see page 181.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

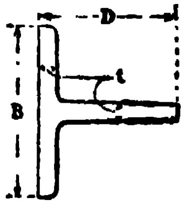
Each weight per foot is for the shaft only. Weight of batten plates, rivets, base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W=actual eccentric load ; K=relative eccentricity coefficient ; We=equivalent concentric value ; We=W×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables see notes commencing page 192.



STANCHIONS (or STRUTS).

Steel Tees.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, B × D × t inches.	HEIGHTS IN FEET.												
		2	3	4	5	6	7	8	9	10	11	12	13	14
21*e* W	6 × 4 × ½	31·7	31·4	30·9	30·3	29·6	28·8	27·8	26·8	25·6	21·3	17·9	15·3	*13·1*
20*e* W	6 × 3 × ½	28·1	27·5	26·7	25·6	24·3	22·8	17·5	13·8	11·2				
20*d* W	〃 × ⅜	21·5	21·0	20·4	19·6	18·6	17·5	13·7	10·8	8·7				
19*e* W	5 × 4 × ½	28·3	28·0	27·6	27·0	26·3	25·5	24·6	23·6	21·3	17·6	14·8	12·6	*10·9*
19*d* W	〃 × ⅜	21·6	21·4	21·0	20·6	20·0	19·4	18·7	17·9	15·7	13·0	10·9	9·3	*8·0*
17*e* W	5 × 3 × ½	24·8	24·3	23·6	22·8	21·7	20·5	16·7	13·2	10·7				
17*d* W	〃 × ⅜	18·9	18·6	18·1	17·4	16·7	15·8	13·1	10·3	8·4	*6·9*			
16*e* W	4 × 5 × ½	28·1	27·5	26·6	25·5	24·2	22·4	17·1	13·5	11·0				
16*d* W	〃 × ⅜	21·4	20·9	20·2	19·4	18·3	16·4	12·5	9·9	8·0				

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

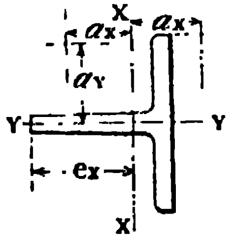
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

STANCHIONS (or STRUTS).

Steel Tees.

Dimensions and Properties.



Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
6 × 4 × ½	16·22	4·771	3·03	1·34	**1·18**	1 + 1·66a_Y	**1 + 2·39a_X**
6 × 3 × ½	14·53	4·272	2·32	1·42	**0·78**	1 + 1·48a_Y	**1 + 3·76a_X**
,, × ⅜	11·08	3·260	2·37	1·40	**0·79**	1 + 1·53a_Y	**1 + 3·75a_X**
5 × 4 × ½	14·51	4·268	2·95	**1·08**	1·16	**1 + 2·13a_Y**	1 + 2·18a_X
,, × ⅜	11·07	3·257	3·00	**1·06**	1·17	**1 + 2·21a_Y**	1 + 2·19a_X
5 × 3 × ½	12·79	3·762	2·26	1·15	**0·82**	1 + 1·87a_Y	**1 + 3·37a_X**
,, × ⅜	9·78	2·875	2·31	1·13	**0·83**	1 + 1·94a_Y	**1 + 3·37a_X**
4 × 5 × ½	14·50	4·264	3·47	**0·78**	1·56	**1 + 3·31a_Y**	1 + 1·43a_X
,, × ⅜	11·06	3·253	3·53	**0·76**	1·54	**1 + 3·45a_Y**	1 + 1·48a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

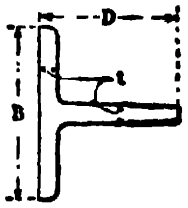
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

REDPATH, BROWN & CO., LIMITED.



STANCHIONS (or STRUTS).

Steel Tees.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, B × D × t inches.	HEIGHTS IN FEET.									
		2	3	4	5	6	7	8	9	10	11
15*e* W	4 × 4 × ½	24·8	24·3	23·7	22·8	21·8	20·6	17·2	13·6	11·0	9·1
15*d* W	" × ⅜	18·9	18·6	18·0	17·4	16·6	15·6	12·6	10·0	8·1	
14*e* W	4 × 3 × ½	21·5	21·1	20·6	19·9	19·0	18·1	15·7	12·4	10·0	*8·3*
14*d* W	" × ⅜	16·5	16·2	15·8	15·3	14·6	13·9	12·3	9·7	7·9	*6·5*
13*e* W	3½ × 3½ × ½	21·4	20·9	20·1	19·2	18·1	15·2	11·6	9·2		
13*d* W	" × ⅜	16·4	15·9	15·4	14·6	13·7	11·1	8·5	6·7		
11*e* W	3 × 3 × ½	18·0	17·4	16·6	15·6	13·2	9·7	7·4			
11*d* W	" × ⅜	13·8	13·3	12·7	11·8	9·6	7·1	5·4			
8*d* W	2½ × 2½ × ⅜	11·2	10·7	9·9	8·0	5·6					
8*b* W	" × ¼	7·7	7·3	6·7	5·1	3·5					

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192.

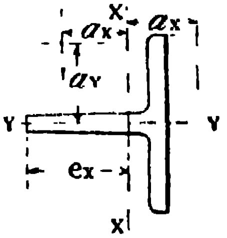
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

STANCHIONS (or STRUTS).

Steel Tees.

Dimensions and Properties.



Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Distance e_X inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
4 × 4 × ½	12·78	3·758	2·84	**0·83**	1·20	**1 + 2·90a_Y**	1 + 1·98a_X
" × ⅜	9·77	2·872	2·89	**0·81**	1·21	**1 + 3·02a_Y**	1 × 1·98a_X
4 × 3 × ½	11·08	3·260	2·18	0·89	**0·85**	1 + 2·51a_Y	**1 + 3·01a_X**
" × ⅜	8·49	2·498	2·23	0·87	**0·86**	1 + 2·61a_Y	**1 + 3·00a_X**
3½ × 3½ × ½	11·08	3·258	2·46	**0·73**	1·04	**1 + 3·26a_Y**	1 + 2·27a_X
" × ⅜	8·49	2·496	2·51	**0·71**	1·05	**1 + 3·41a_Y**	1 + 2·27a_X
3 × 3 × ½	9·38	2·760	2·08	**0·63**	0·88	**1 + 3·71a_Y**	1 + 2·65a_X
" × ⅜	7·21	2·121	2·13	**0·62**	0·89	**1 + 3·90a_Y**	1 + 2·65a_X
2½ × 2½ × ⅜	5·92	1·741	1·75	**0·52**	0·74	**1 + 4·61a_Y**	1 + 3·17a_X
" × ¼	4·07	1·197	1·80	**0·50**	0·75	**1 + 4·96a_Y**	1 + 3·19a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

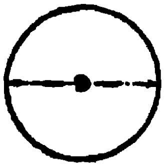
We = actual eccentric load ; K = relative eccentricity coefficient ; Wc = equivalent concentric value ; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192.

For Stanchions in Buildings of Steel Skeleton Construction in London (see Part VI.).

REDPATH, BROWN & CO., LIMITED.

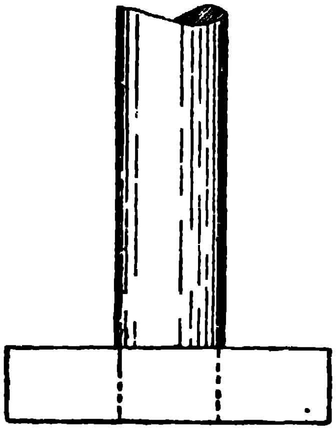


STANCHIONS (or COLUMNS).

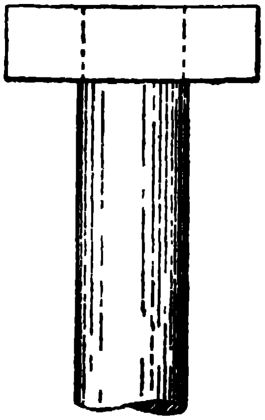
Solid Round Steel.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D inches.	HEIGHTS IN FEET.												
		6	8	10	12	14	16	18	20	22	24	26	28	30
23 X	12	749	743	736	726	715	702	687	671	653	634	613	552	481
22 X	11½	688	682	674	664	653	640	626	609	592	572	540	465	405
21 X	11	628	623	615	605	594	581	566	550	533	514	452	390	339
20 X	10½	572	566	558	549	538	525	510	494	476	440	375	323	282
19 X	10	518	512	504	495	484	471	456	440	423	362	309	266	232
18 X	9½	467	461	453	444	432	419	405	389	351	295	251	217	189
17 X	9	418	412	404	395	384	371	357	341	283	238	203	175	152
16 X	8½	372	366	358	349	338	325	311	272	225	189	161	139	
15 X	8	329	323	315	305	294	282	264	214	176	148	126		
14 X	7½	288	282	274	265	254	241	204	165	136	114			



BASE;



CAP.

Bases and Caps are formed of heavy steel slabs, bored out and shrunk on to the accurately machined column ends.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

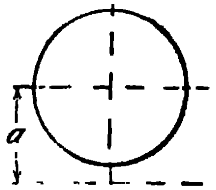
Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel, having "both ends flat."

Safe loads for the condition of "both ends fixed" are identified with tabular loads on the heights to left of zigzag line.

For other conditions and formulæ, see notes commencing page 192

For explanations of properties, &c., see Part IV.

STANCHIONS (or COLUMNS).
Solid Round Steel.
Dimensions and Properties.



Diameter in inches.	Weight per foot in lbs.	Area in square inches.	Radius of Gyration.	Eccentricity Coefficients.	
				For Semi-diameter.	General.
12	384·6	113·100	3·000	5	1+0·67*a*
11½	353·2	103·870	2·875	5	1+0·70*a*
11	323·2	95·033	2·750	5	1+0·73*a*
10½	294·5	86·590	2·625	5	1+0·76*a*
10	267·1	78·540	2·500	5	1+0·80*a*
9½	241·0	70·882	2·375	5	1+0·84*a*
9	216·3	63·617	2·250	5	1+0·89*a*
8½	193·0	56·745	2·125	5	1+0·94*a*
8	170·9	50·265	2·000	5	1+1·00*a*
7½	150·3	44·179	1·875	5	1+1·07*a*

SLABS OF THE UNDERNOTED WIDTHS AND THICKNESSES ARE STOCKED IN LENGTHS OF ABOUT 12 FEET.

Width and Thickness. Inches.	Suitable for Diameters.	Width and Thickness. Inches.	Suitable for Diameters.
18 × 4	10 to 8 inches.	10 × 2	5 to 4 inches.
16 × 3½	8 to 7 "	9 × 1¾	4 to 3½ "
14 × 3	7 to 6 "	8 × 1½	3½ to 2½ "
12 × 2½	6 to 5 "	—	—

Above sizes are for concentric loading.

Special calculations are necessary for the design of slab cap plates supporting eccentric loads. See Part IV.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

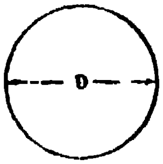
We=actual eccentric load; K=relative eccentricity coefficient; Wc=equivalent concentric value; Wc=We×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for *a*.

For full explanations of tables, see notes commencing page 192.

For Stanchions in Buildings of Steel Skeleton Construction in London (see Part VI.)

REDPATH, BROWN & CO., LIMITED.

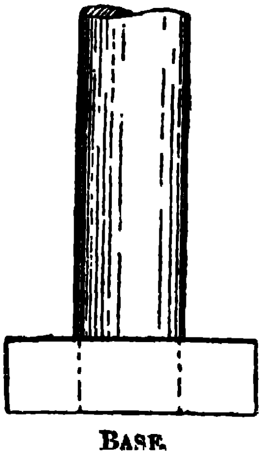


STANCHIONS (or COLUMNS).

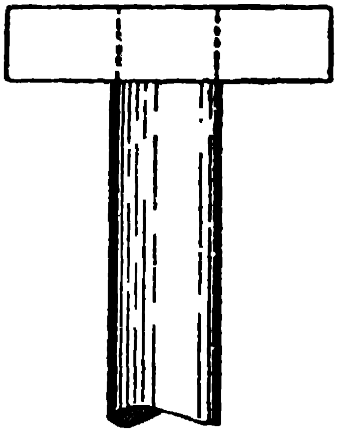
Solid Round Steel.

Safe Concentric Loads, in Tons.
Ends Flat.

Reference Mark.	Size, D inches.	HEIGHTS IN FEET.												
		4	6	8	10	11	12	13	14	15	16	18	20	22
13 X	7	254	250	244	236	231	227	221	216	210	196	155	125	103
12 X	6½	219	214	208	201	196	191	186	180	165	145	115	93·1	
11 X	6	186	181	175	168	163	158	153	138	120	105	83·4	67·6	
10 X	5½	155	151	145	137	133	128	113	97·4	84·9	74·6	58·9		
9 X	5	128	124	118	110	106	90·6	77·2	66·5	58·0	50·9			
8 X	4½	103	98·7	92·7	85·3	70·7	59·4	50·6	43·7	38·0				
7 X	4	80·7	76·4	70·4	53·4	44·1	37·1	31·6						
6 X	3½	61·0	56·7	48·9	31·3	25·9								
5 X	3	43·9	39·6	26·4	16·9									
4 X	2½	29·4	22·6	12·7										



BASE.



CAP.

Bases and Caps are formed of heavy steel slabs, bored out and shrunk on to the accurately machined column ends.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are calculated by the Moncrieff Formulæ for stanchions of mild steel having "both ends flat."

Safe loads for the condition of "both ends fixed" are identical with tabular loads on the heights to left of zigzag line.

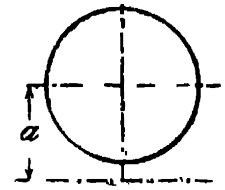
For other conditions and formulæ, see notes commencing page 192.

For explanation of properties, &c., see Part IV.

STANCHIONS (or COLUMNS).

Solid Round Steel.

Dimensions and Properties.



Diameter in inches.	Weight per foot in lbs.	Area in square inches.	Radius of Gyration.	Eccentricity Coefficients.	
				For Semi-diameter.	General.
7	130·9	38·485	1·750	5	$1+1{\cdot}15a$
6½	112·9	33·183	1·625	5	$1+1{\cdot}23a$
6	96·13	28·274	1·500	5	$1+1{\cdot}34a$
5½	80·78	23·758	1·375	5	$1+1{\cdot}46a$
5	66·76	19·635	1·250	5	$1+1{\cdot}60a$
4½	54·07	15·904	1·125	5	$1+1{\cdot}78a$
4	42·72	12·566	1·000	5	$1+2{\cdot}00a$
3½	32 71	9·621	0·875	5	$1+2{\cdot}29a$
3	24·03	7·069	0·750	5	$1+2{\cdot}67a$
2½	16·69	4·909	0·625	5	$1+3{\cdot}20a$

SLABS OF THE UNDERNOTED WIDTHS AND THICKNESSES ARE STOCKED IN LENGTHS OF ABOUT 12 FEET.

Width and Thickness. Inches.	Suitable for Diameters.	Width and Thickness. Inches.	Suitable for Diameters.
18 × 4	10 to 8 inches.	10 × 2	5 to 4 inches
16 × 3½	8 " 7 "	9 × 1¾	4 " 3½ "
14 × 3	7 " 6 "	8 × 1½	3½ " 2½ "
12 × 2½	6 " 5 "		

Above sizes are for concentric loading.

Special calculations are necessary for the design of slab cap plates supporting eccentric loads. See Part IV.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

We=actual eccentric load; K=relative eccentricity coefficient; Wc=equivalent concentric value; Wc=We×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a.

For full explanations of tables, see notes commencing page 192.

PART II.

Explanations of the Tables.

Pages 122 to 191 inclusive.

See Part IV. for general formulæ, explanations of properties, &c.

Part II.

All the tables in this part relate to simple and compound sections, as stanchions, struts or columns.

Arrangement.

The arrangement is similar to that of Part I., precedence being given to the types of stanchions most frequently used.

Compound Stanchions.

A full range of plate thicknesses is given for each joist and channel compound stanchion.

In a series of superimposed stanchions it is convenient and economical to retain the same section of joist or channel throughout, varying the plate areas only, in accordance with the loads.

The tables afford a ready means of selecting suitable types for this purpose.

Latticed Stanchions.

The tabulated safe loads for each latticed stanchion assume efficient bracing between the individual members composing the shaft.

Conventional *minimum* proportions of lattice bars and batten plates for concentric loading are indicated on the tables. Practical considerations will frequently cause the minimum proportions (especially of batten plates) to be increased considerably.

The conventional minimum proportions are not applicable to stanchions under "intentionally" eccentric loading.

Certain formulæ for the design of lattice bars are noticed in Part IV.

Angle and Tee Stanchions or Struts.

In structural steel work applied to buildings, angle and tee stanchions or struts are usually the compression members of lattice girders or roof trusses.

The tabulated safe loads for the condition of "both ends flat" are generally applicable to such members, unless each end connection consists of one bolt or one rivet only.

In the latter case refer to the condition of "both ends round," page 199.

Solid Rounds.

Solid round steel stanchions or columns are most useful in positions where considerations of space are of primary importance. For a given load the possible minimum of overall dimensions is attainable with this type.

Particular care should be taken to ensure *concentric* loading on solid round steel stanchions, as the effect of eccentricity is relatively very great.

Details.

Various types of stanchions, with suitable designs for bases, caps and connections, are illustrated in Part V.

Dimensions and Properties.

All dimensions are stated in inches and all properties in inch units.

Overall Sizes.

D = depth, B = breadth, and t = thickness.

Composition.

The composition of compound stanchions is described in the first columns of the right hand pages in the same manner as in Part I.

Plate Thicknesses.

When the plating on each flange exceeds ¾ of an inch, two or more plates may be used to form the total thickness required.

Rivet Pitch. The Standard rivet pitch for compound stanchions is 6 inches, the diameter being ⅞ inch or ¾ inch as indicated on the tables.

Weights per foot. Each weight per foot in lbs. of compound plated stanchions, and of double angles back to back, includes an allowance for rivet heads at standard pitch.

Each weight per foot in lbs. is that of the plain or riveted shaft only. The weight of base, cap, connections, lattice bracing, batten plates, extra rivets, &c., requires to be added in estimating the total weight of a complete stanchion.

Areas. Each area in square inches is the superficial area of a cross section at right angles to the longitudinal axis.

Radii of Gyration. Least and greatest radii of gyration are tabulated for each stanchion.

The least radius of gyration is invariably printed in prominent type.

For each joist and channel and stanchions compounded of these—excepting No. 24 L, page 137, and Nos. 32 M to 29 M inclusive, page 149—the least radius of gyration is about "Axis Y—Y" passing through the centre of gravity of the figure and parallel to the web or webs. The greatest radius of gyration for each of these sections is about "Axis X—X" passing through the centre of gravity of the figure and parallel to the flanges.

The converse applies to Nos. 24 L and 32 M to 29 M noted above.

The tabulated radii of gyration for each tee and tee-shaped stanchion formed of two angles back to back are also about central axes, but the least radius may be about "Axis Y—Y" parallel to the stalk, or about "Axis X—X" parallel to the table, depending upon the dimensions of the section.

Radii of Gyration.

For each simple or latticed angle stanchion, the least radius of gyration is about the major "Axis V—V" of the inertia ellipse. The greatest radius for each of these sections is about the minor "Axis U—U" of the inertia ellipse.

For solid round steel stanchions, all radii of gyration about central axes are identical.

Rivet Holes.

No deduction is made for rivet holes in the calculation of radii of gyration of compound sections.

Tabular Loads.

The tabulated safe loads are without exception relative to the least radius of gyration.

Dimension "d."

Dimension "d" in the tables of compound stanchions, pages 136 to 149, and pages 154 to 159, is the spacing of the component joists or channels upon which the tabulated properties are based.

Any increase or decrease of "d" will therefore increase or decrease the radius of gyration about "Axis Y—Y," and with the exception of No. 24 L, page 137, and Nos. 32 M to 29 M, page 149, will also increase or decrease the tabulated safe loads.

The maximum increase of safe load is reached when "Axis X—X" becomes the axis of least radius, safe loads relative to this axis being constant for all values of "d."

The tabulated safe loads for No. 24 L and Nos. 32 M to 29 M are the maximum for these sections and will be decreased when "Axis Y—Y" becomes the axis of least radius.

Concentric Loading.

Each tabular load is described as "safe concentric."

This implies that the centre of application of the load or system of loading is, so far as practically possible, coincident with the central vertical axis of the stanchion, or, in other words, that there is no intentional eccentricity of loading.

Ratio of Slenderness.

If the height of a stanchion is divided by its least radius of gyration in the same unit dimension (both generally expressed in inches) the quotient is termed the "ratio of slenderness."

l = height of stanchion in inches.
k = least radius of gyration in inches
$\frac{l}{k}$ = ratio of slenderness.

Limiting Heights.

In the tables the nearest even height of a stanchion not exceeding that for which the "ratio of slenderness" is equal to 160 is taken as the limiting height for which a safe load is given.

Some authorities prefer to limit the height of a stanchion to the lesser of the two values:

(1) 160 times the least radius of gyration.
(2) 40 times the least overall dimension D or B.

Frequently limit (2) gives a lower height than limit (1).

Italics.

For this reason safe loads on all heights greater than the limiting height by (2) are printed in italics in the tables.

Stanchion Formulæ.

After careful consideration the stanchion formulæ deduced * by Mr. J. Mitchell Moncrieff, M.Inst.C.E., M.Amer.Soc.C.E., Newcastle-on-Tyne, have been adopted for this book.

MONCRIEFF WORKING FORMULÆ

For Stanchions of Mild Steel under Concentric Loading having—

Both ends round.

$$\frac{l}{k} = 100\sqrt{\left(\frac{21{\cdot}4}{53{\cdot}5 - 4{\cdot}4f}\right)\left(\frac{10{\cdot}7}{f} - 1{\cdot}6\right)} \quad \ldots \quad \ldots \quad (1).$$

Both ends fixed for all values of $\frac{l}{k}$ and

Both ends flat for values of $\frac{l}{k}$ not exceeding 106·9.

$$\frac{l}{k} = 200\sqrt{\left(\frac{21{\cdot}4}{53{\cdot}5 - 4{\cdot}4f}\right)\left(\frac{10{\cdot}7}{f} - 1{\cdot}6\right)} \quad \ldots \quad \ldots \quad (2).$$

Both ends flat for values of $\frac{l}{k}$ exceeding 106·9.

$$\frac{l}{k} = 200\sqrt{\frac{21{\cdot}4 \times 0{\cdot}4}{5{\cdot}6f}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3).$$

l = height of stanchion in inches.

k = radius of gyration in inches.

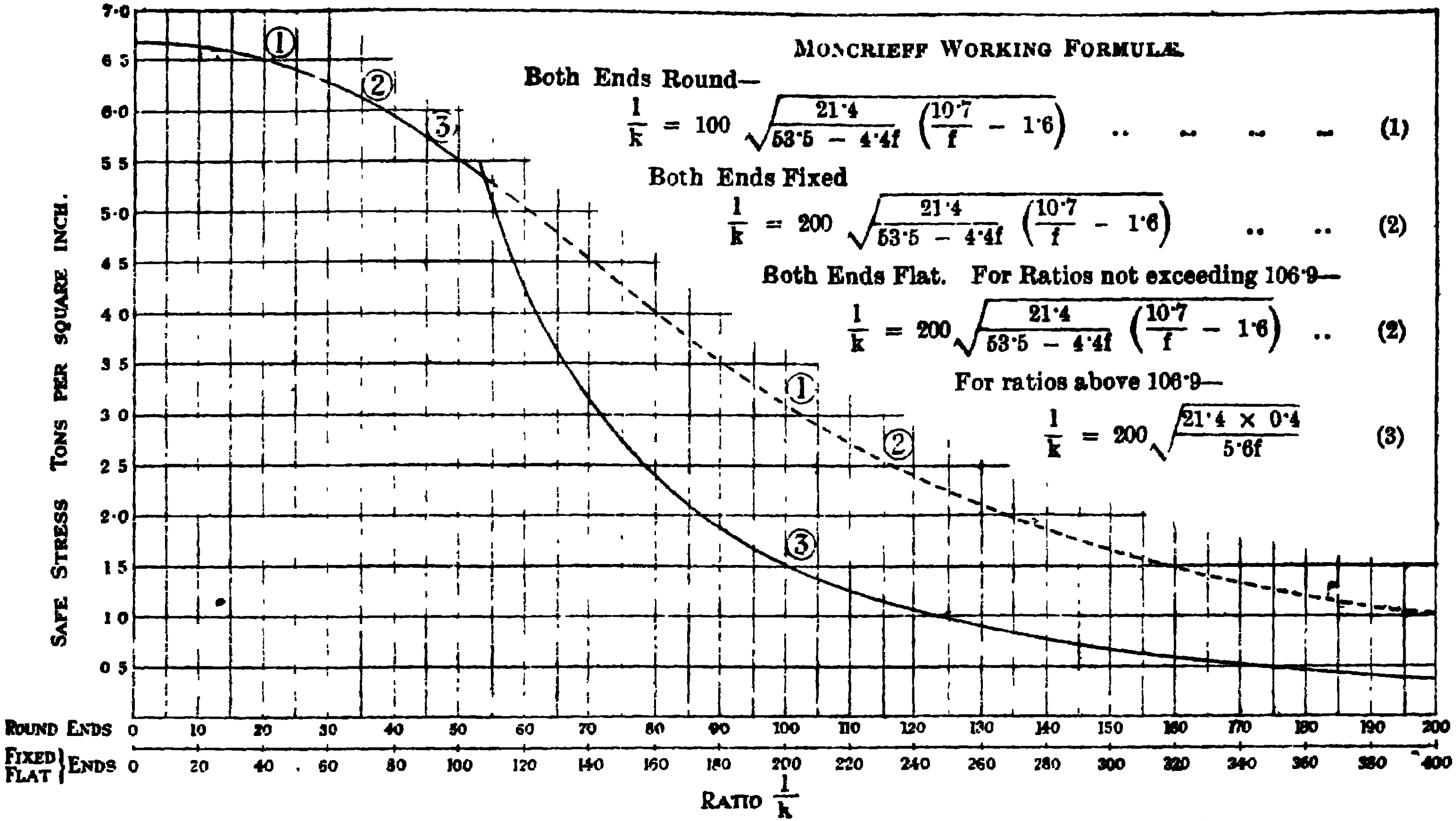
$\frac{l}{k}$ = ratio of slenderness.

f = average allowable load or working compressive stress per square inch of sectional area in tons per square inch.

The tabular safe loads are by Formulæ (2) and (3) for the condition of "both ends flat."

REDPATH, BROWN & CO., LIMITED.

SAFE UNITAL STRESSES IN TONS PER SQUARE INCH
BY MONCRIEFF FORMULÆ
FOR STANCHIONS OF MILD STEEL UNDER CONCENTRIC LOADING.



Moncrieff Working Formulæ.

Both Ends Round—

$$\frac{1}{k} = 100\sqrt{\frac{21{\cdot}4}{53{\cdot}5 - 4{\cdot}4f}\left(\frac{10{\cdot}7}{f} - 1{\cdot}6\right)} \quad .. \quad .. \quad .. \quad .. \quad (1)$$

Both Ends Fixed

$$\frac{1}{k} = 200\sqrt{\frac{21{\cdot}4}{53{\cdot}5 - 4{\cdot}4f}\left(\frac{10{\cdot}7}{f} - 1{\cdot}6\right)} \quad .. \quad .. \quad (2)$$

Both Ends Flat. For Ratios not exceeding 106·9—

$$\frac{1}{k} = 200\sqrt{\frac{21{\cdot}4}{53{\cdot}5 - 4{\cdot}4f}\left(\frac{10{\cdot}7}{f} - 1{\cdot}6\right)} \quad .. \quad (2)$$

For ratios above 106·9—

$$\frac{1}{k} = 200\sqrt{\frac{21{\cdot}4 \times 0{\cdot}4}{5{\cdot}6f}} \quad (3)$$

Curve (1). Round Ended Stanchions. Variation of Unital Stresses for Ratios of $\frac{1}{k}$ from 0 to 200.

Curve (2). Fixed Ended Stanchions. Variation of Unital Stresses for Ratios of $\frac{1}{k}$ from 0 to 400.

Curve (3). Flat Ended Stanchions. Variation of Unital Stresses for Ratios of $\frac{1}{k}$ from 0 to 400.

Working Stresses, in Tons, per square inch of Section for Stanchions of Mild Steel under Concentric Loading by Moncrieff Formulæ.

$\frac{l}{k}$	(1)	(2)	(3)	$\frac{l}{k}$	(1)	(2)	(3)	$\frac{l}{k}$	(1)	(2)	(3)
4	6·68	6·69		76	4·21	6·01		121	2·35	5·01	4·18
8	6·66	6·68		77	4·16	5·99		122	2·32	4·98	4·11
12	6·62	6·67		78	4·11	5·97		123	2·29	4·96	4·05
16	6·57	6·66		79	4·06	5·95		124	2·26	4·93	3·98
20	6·50	6·65		80	4·01	5·93		125	2·24	4·91	3·92
22	6·46	6·64		81	3·96	5·92		126	2·21	4·88	3·85
24	6·42	6·62		82	3·91	5·90		127	2·18	4·85	3·79
26	6·37	6·61		83	3·86	5·88		128	2·15	4·83	3·74
28	6·32	6·60		84	3·81	5·86		129	2·13	4·80	3·68
30	6·27	6·59		85	3·76	5·84		130	2·10	4·78	3·62
32	6·21	6·57		86	3·71	5·82		132	2·05	4·73	3·51
34	6·14	6·56		87	3·67	5·80		134	2·00	4·67	3·41
36	6·08	6·54		88	3·62	5·78		136	1·95	4·62	3·31
38	6·01	6·52		89	3·57	5·76		138	1·91	4·57	3·21
40	5·93	6·50		90	3·52	5·74		140	1·86	4·52	3·12
42	5·86	6·48		91	3·48	5·71		142	1·82	4·47	3·03
44	5·78	6·46		92	3·43	5·69		144	1·78	4·42	2·95
46	5·69	6·44		93	3·39	5·67		146	1·74	4·36	2·87
48	5·60	6·42		94	3·34	5·65		148	1·70	4·31	2·79
50	5·52	6·40		95	3·30	5·63		150	1·66	4·26	2·72
51	5·47	6·39		96	3·26	5·60		152	1·62	4·21	2·65
52	5·42	6·37		97	3·21	5·58		154	1·58	4·16	2·58
53	5·38	6·36		98	3·17	5·56		156	1·55	4·11	2·51
54	5·33	6·35		99	3·13	5·54		158	1·51	4·06	2·45
55	5·28	6·34		100	3·09	5·52		160	1·48	4·01	2·39
56	5·23	6·32		101	3·05	5·49		162	1·45	3·96	2·33
57	5·18	6·31		102	3·01	5·47		164	1·42	3·91	2·27
58	5·13	6·30		103	2·97	5·45		166	1·39	3·86	2·22
59	5·08	6·28		104	2·93	5·42		168	1·36	3·81	2·17
60	5·03	6·27		105	2·89	5·40		170	1·33	3·76	2·12
61	4·98	6·25		106	2·86	5·38		172	1·30	3·71	2·07
62	4·93	6·24		107	2·82	5·35	5·35	174	1·28	3·67	2·02
63	4·88	6·22		108	2·78	5·33	5·25	176	1·25	3·62	1·97
64	4·83	6·21		109	2·75	5·30	5·15	178	1·23	3·57	1·93
65	4·78	6·19		110	2·71	5·28	5·06	180	1·20	3·52	1·89
66	4·73	6·18		111	2·67	5·26	4·97	182	1·18	3·48	1·85
67	4·67	6·16		112	2·64	5·23	4·88	184	1·16	3·43	1·81
68	4·62	6·14		113	2·61	5·21	4·79	186	1·13	3·39	1·77
69	4·57	6·13		114	2·57	5·18	4·71	188	1·11	3·34	1·73
70	4·52	6·11		115	2·54	5·16	4·63	190	1·09	3·30	1·69
71	4·47	6·10		116	2·51	5·13	4·55	192	1·07	3·26	1·66
72	4·42	6·08		117	2·47	5·11	4·47	194	1·05	3·21	1·62
73	4·36	6·06		118	2·44	5·08	4·40	196	1·03	3·17	1·59
74	4·31	6·04		119	2·41	5·06	4·32	198	1·01	3·13	1·56
75	4·26	6·02		120	2·38	5·03	4·25	200	0·99	3·09	1·53

(1) = Working Stresses for "both ends round" by Formula (1).
(2) = " " " "both ends fixed" " " (2).
(2) (3) = " " " "both ends flat" " " (2).
(3) = " " " "both ends flat." " " (3).

For Stanchions of Buildings of Steel Skeleton Construction in London (see Part VI.)

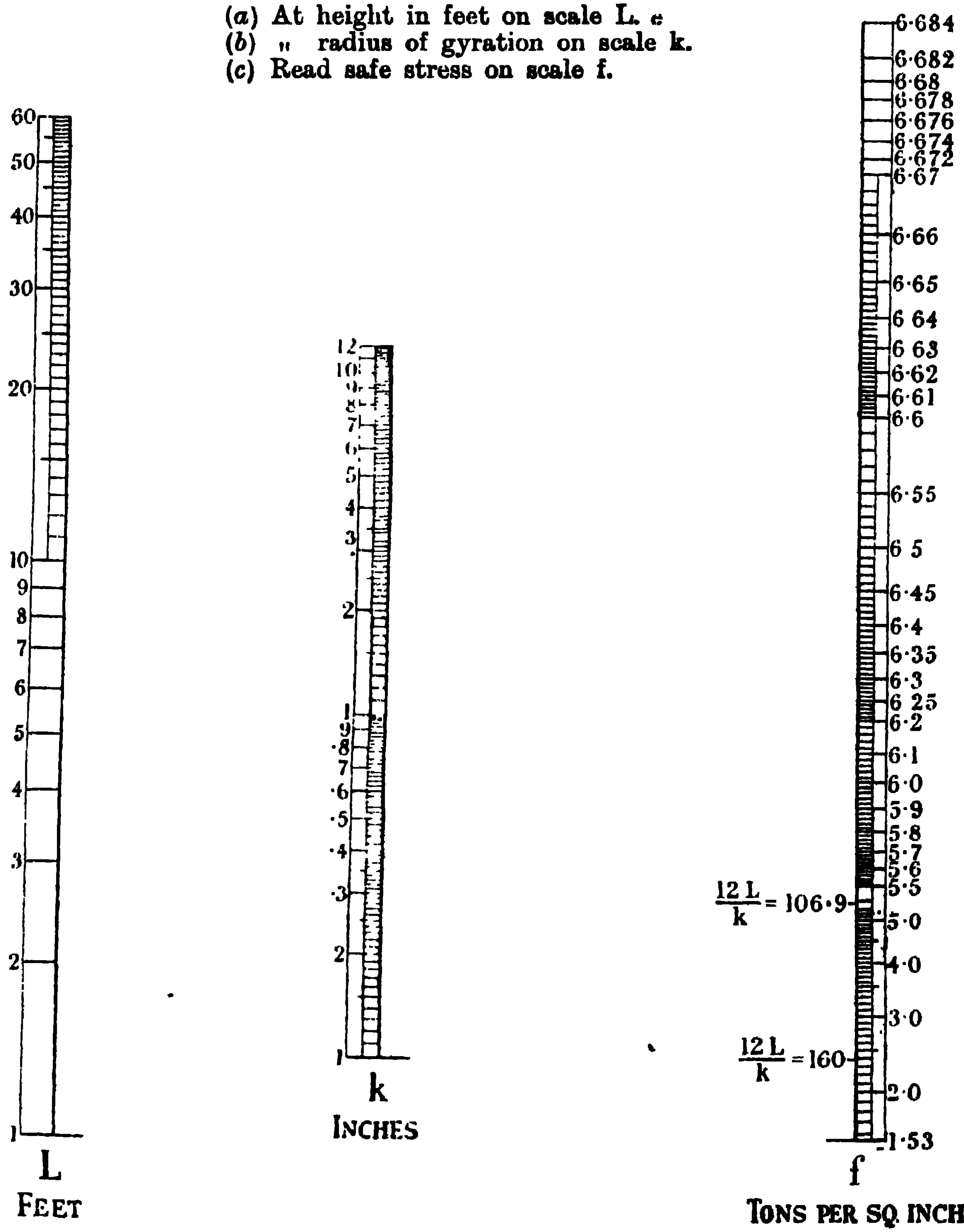
REDPATH, BROWN & CO., LIMITED.

Stanchions. **Moncrieff Formulæ.**

ALIGNMENT CHART I.

Lay transparent straight edge across scales—

(*a*) At height in feet on scale L.
(*b*) " radius of gyration on scale k.
(*c*) Read safe stress on scale f.

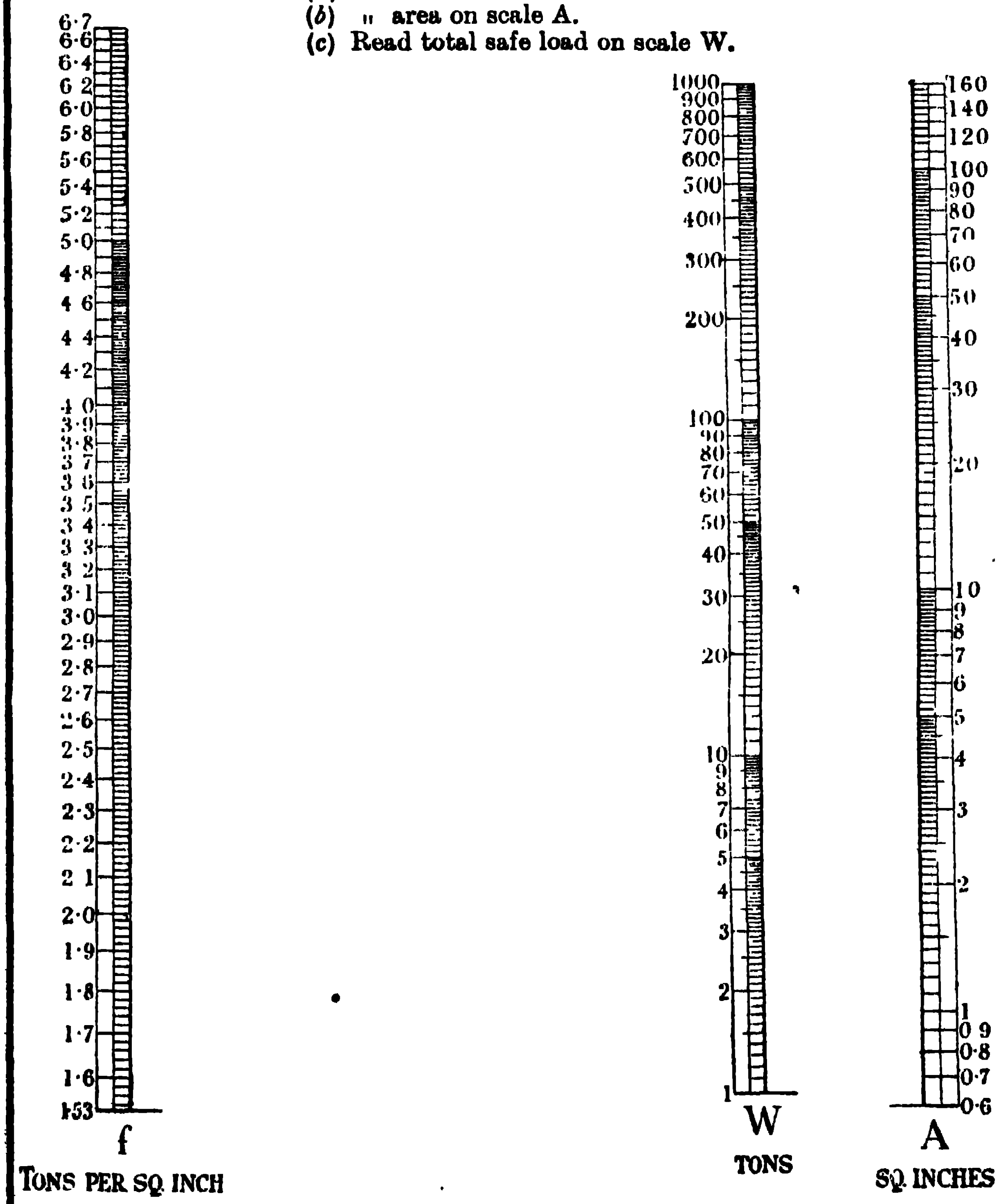


Stanchions. **Moncrieff Formulæ.**

ALIGNMENT CHART II.

Lay transparent straight edge across scales—

(*a*) At safe stress on scale f.
(*b*) " area on scale A.
(c) Read total safe load on scale W.



Moncrieff Formulæ.

The following notes, pages 202, 203, and 204, are extracted from or based directly on Mr. Moncrieff's paper (see Proceedings Amer. Soc. C.E., Vol. XXVI., 1900).

The underlying principles upon which the reasoning is based are:—

(1) that a perfectly centred column of perfect material and straightness is an ideal conception seldom or never realised in practice, and

(2) that the various disturbing influences are practically all capable, as regards their ultimate effect, of being represented by an equivalent eccentricity of loading.

A careful study of no less than 1789 reliable tests of columns was undertaken to determine "the value to be assigned to the equivalent eccentricity applicable to the case of columns under apparently central loading."

The important result of this analysis is that the Moncrieff Formulæ include an "equivalent eccentricity" factor to allow for the inherent but practically unobservable defects of the practical column, apart altogether from considerations of intentional eccentricity, treated later in these notes.

Factors of Safety.

Other special features of the Moncrieff Formulæ are that, in preference to the usual method of stanchion design with regard to ultimate strength alone, they ensure:—

(1) that prescribed maximum allowable fibre stresses will not be exceeded under the working load.

Factors of Safety.

This condition is complied with by the adoption of a reasonable maximum value for the extreme fibre compressive stress, and

(2) that in addition a sufficient margin against failure by "elastic instability" is provided in stanchions of longer lengths. The latter coefficient of safety is applied directly to the Modulus of Elasticity of the material.

It is important to note that while the factor of safety against ultimate strength retains a constant value, the use of the additional coefficient of safety against instability in the foregoing manner has an inappreciable influence on the results of the formulæ when applied to short columns, but a gradually increasing effect as the height of the column is increased.

Condition of Ends.

Mr. Moncrieff's theory is founded on the elementary column having "both ends round."

With regard to the condition of "both ends fixed" he states: "In actual practice the true 'fixed-ended' column rarely if ever exists. It is difficult, even in experiments in a testing machine, to comply with the conditions necessary to ensure absolute fixity of ends, and in ordinary construction the difficulty is increased greatly."

"Both ends flat."

In building practice the term "both ends fixed" may, with advantage, be entirely discarded in favour of the term "both ends flat."

Prior to Mr. Moncrieff's investigations no attempt had been made to arrive at a rational basis for the strength of flat-ended columns, although the greater number of tests of columns had been made with this class of end bearing.

"Both ends flat."

The usual assumption that "fixed-ended" and "flat-ended" columns act in precisely the same manner is quite erroneous both from a theoretical point of view and from the evidence of actual experiments. The essential distinction is that in the *practical* "flat-ended" column, held in position by pressure of the load and structural bolts or rivets, no tensile stress can be nor is intended to be developed at the ends; in the *theoretical* "fixed-ended" column, on the contrary, a considerable amount of end tensile stress could be developed and safely resisted.

Mr. Moncrieff has shown that in mild steel columns under apparently central loading no end tensile stress is developed provided the ratio of slenderness does not exceed 106·9, and therefore up to this point "fixed-ended" and "flat-ended" columns behave alike. Beyond this point in comparison with the ideal "fixed-ended" column, the strength of the practical "flat-ended" column falls rapidly and should be calculated by Formula (3).

Zig-zag Line.

The zig-zag lines are inserted in the tables to separate the series of safe loads for ratios of slenderness below and above 106·9.

The safe loads to the left of the lines are identical for "both ends flat" and "both ends fixed." The more rapidly decreasing safe loads for ascending heights to the right of the lines are applicable in particular to the condition of "both ends flat."

Eccentric Loading.

Eccentric loading is of two descriptions, viz.:—"accidental" and "intentional."

Accidental Eccentricity.

The effect of "accidental eccentricity" is fully allowed for by the Moncrieff Stanchion Formulæ.

(End of Notes on Moncrieff Formulæ.)

Intentional Eccentricity.

"Intentional eccentricity" occurs when the perpendicular distance from the centre of application of a load or system of loading to either or both "principal axes" of the stanchion is a quantity measurable by ordinary practical methods.

Eccentricity (general).

In these notes by "eccentricity" will now be understood "intentional eccentricity" as "accidental eccentricity" is not considered further.

Arm of Eccentricity.

The measurable distance referred to above is termed the "arm of eccentricity" and is expressed in inches.

Principal Axes.

The "principal axes" are "the axis of least radius" and "the axis of greatest radius."

Loading.

Loading is said to be "eccentric about the axis" to which the "arm of eccentricity" is perpendicular.

Eccentric Loading.

The tabular eccentricity coefficients are derived from the general formulæ for eccentric loading, for which see Part IV.

For each stanchion, eccentricity coefficients relative to both of the "principal axes" of the section are given.

Prominent Type.

The eccentricity coefficients relative to the "axis of least radius" are printed in prominent type in the tables.

Axial Coefficients.

The coefficients in the tables under headings "Axis Y—Y," "Axis V—V" and "Axis U—U" are respectively relative to these "principal axes" and may be termed "axial coefficients."

To complete the "axial coefficients" it is only necessary to substitute for a_Y, a_X, a_V, or a_U, the actual value in inches of the "arm of eccentricity."

Axial Coefficients.

The "axial coefficients" are of general application for any degree of eccentricity, care being taken to select the coefficient having the same reference letters as the axis about which the loading is eccentric.

Channel Coefficients.

Special note may be made of the "axial coefficients" for each channel stanchion, pages 150 to 153.

As "Axis Y—Y" for this type is not an axis of symmetry, it is necessary to consider on which side of this axis the eccentric loading is placed.

When the "arm of eccentricity" is measured in the same direction as dimension e_Y use coefficient "Axis Y—Y e_Y." and conversely when the centre of application of the load is on the other side of "Axis Y—Y" use coefficient "Axis Y—Y c_Y."

Angle and Tee Coefficients.

For each angle, tee and tee shaped stanchion the "axial coefficients" relative to the assymmetrical axes V—V, U—U, and X—X, take into account the perpendicular distance e_V, e_U, or e_X to the extreme fibre of the section irrespective of the side of the axis on which the loading occurs. The worst case is thus provided for.

Web and Flange Coefficients.

In addition to the "axial coefficients" for each joist and channel, and for each stanchion compounded of either of these sections, there are two coefficients for special conditions of eccentric loading, viz.:—"Web" and "Flange," respectively relative to "Axis Y—Y" and "Axis X—X."

These are applicable when the "arm of eccentricity" is identical with the perpendicular distance from "Axis Y—Y" or "Axis X—X" to the outer surface of the web or flange respectively.

Web and Flange Coefficients.

This is usually taken to be the case in good construction when the eccentric load is transmitted by a girder properly connected to a side of a stanchion.

Equivalent Concentric Load.

By the use of the eccentricity coefficient for the axis about which a load or system of loading is eccentric an "equivalent concentric value" of the load relative to that axis may be obtained.

Let W_e = actual eccentric load in tons.
K = eccentricity coefficient for axis about which W_e is eccentric.
W_c = equivalent concentric load value in tons for that axis.

Then $W_c = W_e \times K$.

Safe Eccentric Load.

It follows from the above that if a tabular concentric load is divided by the eccentricity coefficient printed in prominent type, the maximum safe eccentric load relative to the "axis of least radius" of the section is obtained directly.

Examples.

The following examples illustrate the application of the tables to the design of eccentrically loaded stanchions, and also the use of the Alignment Charts, pages 200 and 201.

(A) Loading eccentric about "axis of least radius" only.

Example 1.—A stanchion 11 feet high supports an eccentric load of 60 tons, transmitted directly to its web surface by a girder.

Required a suitable section.

Select No. 22 J, page 122, steel joist 12 × 6*a* which will support a safe concentric load of 88 tons on 11 feet.

Examples.

Multiply 60 tons, the actual concentric load, by 1·42, the "web" eccentricity coefficient for the section.

The product 85·2 tons is the equivalent concentric load value; therefore the selected stanchion is suitable.

Example 2.—A stanchion 20 feet high supports a system of eccentric loading amounting to 150 tons; the "arm of eccentricity" about the "axis of least radius" being 2 ins.

Required a suitable section.

Select No. 142 M, page 144, composed of two steel joists, 14 × 6½ and two flange plates 14″ × ¾″ which will support a safe concentric load of 300 tons on 20 feet.

Substitute 2 inches, the given "arm of eccentricity," for a_Y and obtain (1 + 0·47 × 2) = 1·94 as the "Axis Y—Y" or "axis of least radius" eccentricity coefficient.

Multiply 150 tons, the actual eccentric load, by 1·94.

The product 291 tons is the equivalent concentric load value, therefore the selected stanchion is suitable.

(B) Loading eccentric about "axis of greatest radius" only.

Example 3.—A stanchion 16 feet high supports an eccentric load of 84 tons transmitted directly to its flange surface by a girder.

Required a suitable section.

Select No. 50 P, page 156, composed of two steel channels 12 × 3½ and two flange plates, 14″ × ½″.

Note height, 16 feet; area, 33·3 square inches, and greatest radius of gyration "Axis X—X," 5·28 inches. **Examples.**

Transfer these values to the Alignment Charts, pages 200 and 201.

On Chart I. lay a straight edge across the three vertical scales at the height 16 feet on scale L, at the radius of gyration 5·28 inches on scale k, and read safe stress as 6·54 tons per square inch on scale f.

On Chart II. lay straight edge at 6·54 tons on scale f, at the area 33·3 square inches on scale A, and read safe concentric load for "Axis X—X" as 217 tons on scale W.

Divide 217 tons by 2·52, the flange eccentricity coefficient for the section.

The quotient 86 tons is the safe flange eccentric load; therefore the selected stanchion is suitable.

Example 4.—A stanchion 16 feet high supports a system of eccentric loading amounting to 165 tons, the "arm of eccentricity" about the "axis of greatest radius" being 1½ inches.

Required a suitable section.

Select No. 191 K, page 128, composed of 1 steel joist 15 × 6 and 2 flange plates 12″ × ⅝″.

Note height 16 feet, area 32·3 square inches and greatest radius of gyration, "Axis X—X," 6·91 inches.

Transfer these values to the Alignment Charts, pages 200 and 201.

On Chart I., by the method described, read safe stress as 6·61 tons per square inch on scale f.

Examples.

On Chart II. read safe concentric load for "Axis X—X" as 213 tons on scale W.

Substitute 1·5, the "arm of eccentricity" for a_x and obtain $(1 + 0{\cdot}17 \times 1{\cdot}5) = 1{\cdot}255$ as the "Axis X—X" or "axis of greatest radius" eccentricity coefficient.

Divide 213 tons by 1·255.

The quotient 170 tons is the safe load for an eccentricitv of 1½ inches about "Axis X—X"; therefore the selected stanchion is suitable.

C.—Loading eccentric about both axes.

Select a stanchion from the tables as in Examples 1 and 2 as if the loading were eccentric about the "axis of least radius" only; then by use of the Alignment Charts and eccentricity coefficient for the "axis of greatest radius" check the section for the load eccentric about "the axis of greatest radius."

Combined Loading.

If a stanchion supports concentric in addition to eccentric loading, the former, if treated separately, must be added to the equivalent concentric load value to give the total equivalent concentric load.

Maximum Load.

The actual load eccentric or concentric for "the axis of greatest radius" must in no case exceed the tabular load—calculated for "the axis of least radius."

For notes on the location of the "centre of application" of load systems, see Part IV.

PART III.

ROOFS.

TYPES OF TRUSSES.

STRESSES,

WIND PRESSURE,

DETAILS,

Etc.

CONTENTS OF PART III.

PAGE

RIDGED ROOF TRUSSES—

Diagrams, Stress and Length Coefficients, - - - 214

Explanations of Tables. Formulæ, - - - - - - 220

WEIGHTS OF COVERINGS, - - - - - - - - - 224

WIND PRESSURE, - - - - - - - - - 225

WIND PRESSURE ALIGNMENT CHART, - - - - - - - 227

EXAMPLE, - - - - - - - - - - 228

REFERENCES, - - - - - - - - - - - 230

GUTTERS AND DOWNPIPES, - - - - - - - - 230

GUTTERS AND DOWNPIPES. CHART, - - - - - - - 231

RIDGED ROOF TRUSSES.

Rise of Rafter = 1/4th Span.
" Main Tie = 1 in 15.

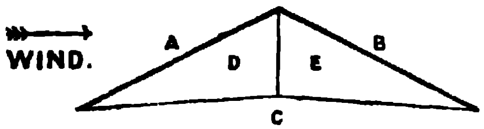


Fig 1*a*

Member.	Stress Coefficients.				Length Coefficient
	Dead Load.		Wind Pressure.		
	Compression.	Tension.	Compression.	Tension.	
A — D	·65		·45		·559
B — E	·65		·70		·559
C — D		·58		·49	·501
C — E		·58		·49	·501
D — E		·08		·07	·217

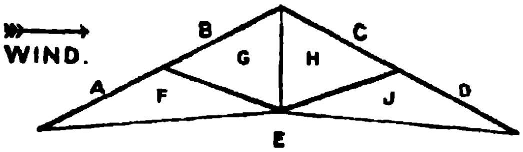


Fig. 2*a*.

Member.	Stress Coefficients.				Length Coefficient.
	Dead Load.		Wind Pressure.		
	Compression.	Tension.	Compression.	Tension.	
A — F	·97		1·05		·280
D — J	·97		·70		·280
B — G	·64		·57		·280
C — H	·64		·70		·280
F — G	·31		·09		·266
H — J	·31		·00		·266
E — F		·87		1·13	·501
E — J		·87		·48	·501
G — H		·33		·34	·217

Rise of Rafter = 1/3rd Span.
" Main Tie = 1 in 12.

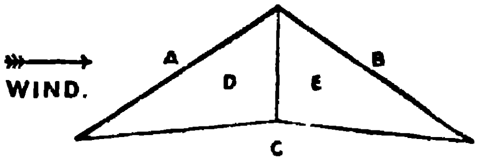


Fig. 1*b*.

Member	Stress Coefficients.				Length Coefficient.
	Dead Load		Wind Pressure.		
	Compression.	Tension.	Compression.	Tension.	
A — D	·52		·25		·601
B — E	·52		·58		·601
C — D		·43		·29	·502
C — E		·43		·29	·502
D — E		·07		·05	·292

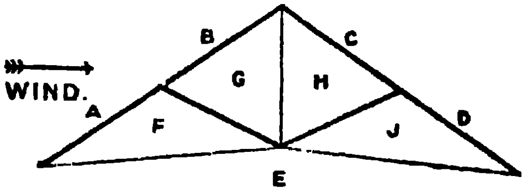


Fig. 2*b*.

Member	Stress Coefficients.				Length Coefficient.
	Dead Load.		Wind Pressure.		
	Compression.	Tension.	Compression.	Tension.	
A — F	·77		·70		·300
D — J	·77		·58		·300
B — G	·51		·42		·300
C — H	·51		·58		·300
F — G	·24		·58		·280
H — J	·24		·00		·280
E — F		·65		·80	·502
E — J		·65		·29	·502
G — H		·32		·35	·292

RIDGED ROOF TRUSSES.

Rise of Rafter = 1/4th Span.
" Main Tie = 1 in 15.

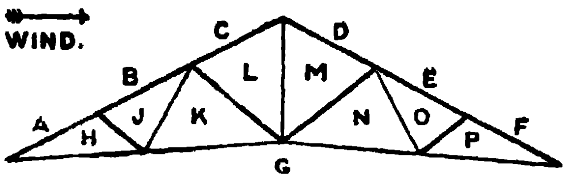


Fig. 3a.

Member.	Stress Coefficients.				Length Coefficient
	Dead Load.		Wind Pressure.		
	Compression.	Tension	Compression	Tension	
A — H	1·08		1·24		·186
F — P	1·08		·70		·186
B — J	·94		1·10		·186
E — O	·94		·70		·186
C — L	·65		·62		·186
D — M	·65		·70		·186
H — J	·17		·37		·107
O — P	·17		·00		·107
K — L	·25		·55		·214
M — N	·25		·00		·214
G — H		·96		1·35	·251
G — P		·96		·48	·251
G — K		·77		·92	·251
G — N		·77		·48	·251
J — K		·13		·80	·171
N — O		·13		·00	·171
L — M		·41		·44	·217

Rise of Rafter = 1/3rd Span.
" Main Tie = 1 in 12.

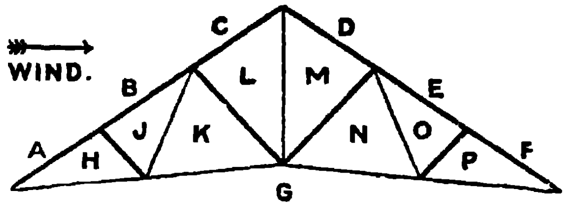


Fig. 3b.

Member.	Stress Coefficients.				Length Coefficient.
	Dead Load		Wind Pressure.		
	Compression.	Tension.	Compression.	Tension.	
A — H	·86		·80		·200
F — P	·86		·58		·200
B — J	·74		·80		·200
E — O	·74		·58		·200
C — L	·51		·47		·200
D — M	·51		·58		·200
H — J	·14		·34		·123
O — P	·14		·00		·123
K — L	·21		·51		·246
M — N	·21		·00		·246
G — H		·72		·98	·251
G — P		·72		·29	·251
G — K		·57		·63	·251
G — N		·57		·29	·251
J — K		·12		·80	·218
N — O		·12		·00	·218
L — M		·40		·45	·292

To find the total stress in any member due to dead load and wind pressure :—

Let L = Span between the points of intersection of the rafter and main tie.
" W_D = Total dead load on one truss including its own weight.
" W_P = Total normal wind pressure acting on one side of one truss.
" P = Total stress required.

Then P = (W_D × dead load coefficient) + (W_P × wind pressure coefficient).

To find the length of any member between points of intersection :—

Multiply the span by the length coefficient for the member required.

The members are lettered according to Bow's notation. See notes page 220.

Prominent type indicates a greater wind pressure stress on the lee member than on the windward member.

RIDGED ROOF TRUSSES.

Rise of Rafter = 1/4th Span.
" Main Tie = 1 in 15.

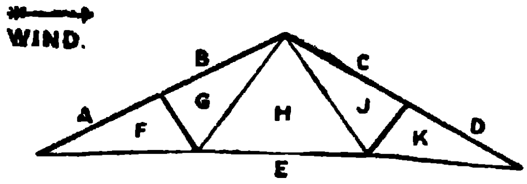


Fig. 4a.

Member.	Stress Coefficients.				Length Coefficient.
	Dead Load.		Wind Pressure		
	Compression.	Tension	Compression.	Tension.	
A — F	·97		1·05		·279
D — K	·97		·70		·279
B — G	·85		1·05		·279
C — J	·85		·70		·279
F — G	·22		·50		·117
J — K	·22		·00		·117
E — F		·87		1·13	·302
E — K		·87		·48	·302
E — H		·54		·46	·395
G — H		·34		·69	·302
H — J		·34		·04	·302

Rise of Rafter = 1/3rd Span.
" Main Tie = 1 in 12.

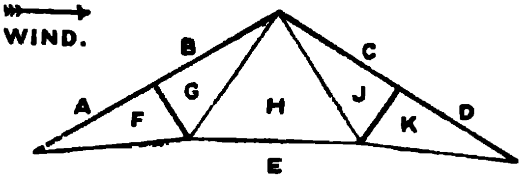


Fig. 4b.

Member.	Stress Coefficients.				Length Coefficient.
	Dead Load.		Wind Pressure.		
	Compression.	Tension.	Compression.	Tension.	
A — F	·77		·70		·300
D — K	·77		·58		·300
B — G	·63		·70		·300
C — J	·63		·58		·300
F — G	·21		·50		·166
J — K	·21		·00		·166
E — F		·65		·80	·343
E — K		·65		·29	·343
E — H		·41		·28	·317
G — H		·26		·54	·343
H — J		·26		·03	·343

To find the total stress in any member due to dead load and wind pressure:—
Let L = span between the points of intersection of the rafter and main tie.
" W_D = total dead load on one truss including its own weight.
" W_P = total normal wind pressure acting on one side of one truss.
" P = total stress required.
Then P = (W_D × dead load coefficient) + (W_P × wind pressure coefficient).
To find the length of any member between points of intersection:—
Multiply the span by the length coefficient for the member required.
The members are lettered according to Bow's notation. See notes page 220.

RIDGED ROOF TRUSSES.

Rise of Rafter = 1/4th Span.
" Main Tie = 1 in 15.

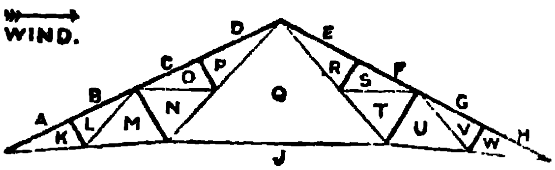


Fig. 5a

Member.	Stress Coefficients. Dead Load. Compression	Dead Load. Tension.	Wind Pressure. Compression	Wind Pressure. Tension.	Length Coefficient.
A — K	1·13		1·34		·140
H — W	1·13		·70		·140
B — L	1·07		1·34		·140
G — V	1·07		·70		·140
C — O	1·02		1·34		·140
F — S	1·02		·70		·140
D — P	·96		1·34		·140
E — R	·96		·70		·140
M — N	·22		·50		·117
T — U	·22		·00		·117
K — L O — P	·11		·25		·059
V — W R — S	·11		·00		·059
J — K		1·01		1·46	·152
J — W		1·01		·48	·152
J — M		·87		1·13	152
J — U		·87		·48	·152
J — Q		·54		·45	·305
Q — N		·34		·69	·152
Q — T		·34		·04	·152
Q — P		·49		1·01	·152
Q — R		·49		·04	·152
L — M N — O		·15		·32	·152
U — V S — T		·15		·00	·152

Rise of Rafter = 1/3rd Span.
" Main Tie = 1 in 12.

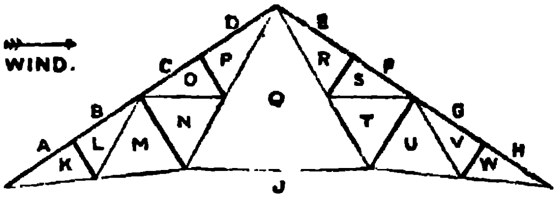


Fig. 5b.

Member	Stress Coefficients. Dead Load Compression	Dead Load Tension.	Wind Pressure. Compression	Wind Pressure. Tension.	Length Coefficient.
A — K	·90		·93		·150
H — W	·90		·58		·150
B — L	·83		·93		·150
G — V	83		·58		·150
C — O	·76		·93		·150
F — S	·76		·58		·150
D — P	·69		·93		·150
E — R	·69		·58		·150
M — N	·21		·50		·166
T — U	·21		·00		·166
K — L O — P	·10		·25		·083
V — W R — S	·10		·00		·083
J — K		·75		1·06	·171
J — W		·75		·29	·171
J — M		·64		·81	·171
J — U		·64		·29	·171
J — Q		·41		·28	·317
Q — N		·26		·55	·171
Q — T		·26		·03	·171
Q — P		·36		·80	·171
Q — R		·36		·03	·171
L — M N — O		·11		·20	·171
U — V S — T		·11		·00	·171

RIDGED ROOF TRUSSES.

Rise of Rafter = 1/4th Span.
" Main Tie = 1 in 15.

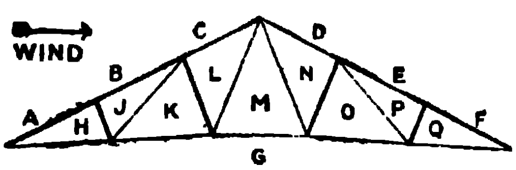


Fig. 6a.

Member	Stress Coefficients.				Length Coefficient
	Dead Load.		Wind Pressure.		
	Compression.	Tension	Compression.	Tension	
A — H	1·08		1·24		·186
F — Q	1·08		·70		·186
B — J	1·00		1·24		·186
E — P	1·00		·70		·186
C — L	·75		·85		·186
D — N	·75		·70		·186
H — J	·15		·33		·078
P — Q	·15		·00		·078
K — L	·22		·50		·155
N — O	·22		·00		·155
G — H		·96		1·35	·200
G — Q		·96		·48	·200
G — K		·77		·92	·200
G — O		·77		·48	·200
G — M		·56		·47	·200
J — K		·19		·43	·203
O — P		·19		·00	·203
L — M		·27		·55	·245
M — N		·27		·04	·245

Rise of Rafter = 1/3rd Span.
" Main Tie = 1 in 12.

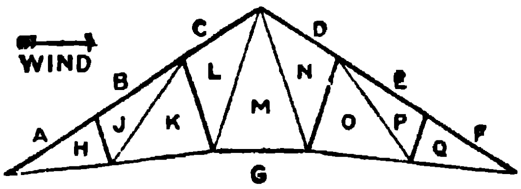


Fig. 6b.

Member.	Stress Coefficients.				Length Coefficient.
	Dead Load.		Wind Pressure.		
	Compression	Tension.	Compression.	Tension.	
A — H	·86		·86		·200
F — Q	·86		·58		·200
B — J	·81		·94		·200
E — P	·81		·58		·200
C — L	·60		·68		·200
D — N	·60		·58		·200
H — J	·14		·34		·100
P — Q	·14		·00		·100
K — L	·22		·52		·200
N — O	·22		·00		·200
G — H		·72		·98	·201
G — Q		·72		·29	·201
G — K		·58		·63	·201
G — O		·58		·29	·201
G — M		·42		·28	·201
J — K		·18		·42	·245
O — P		·18		·00	·245
L — M		·26		·57	·317
M — N		·26		·08	·317

To find the total stress in any member due to dead load and wind pressure :—
Let L = Span between the points of intersection of the rafter and main tie.
" W_D = Total dead load on one truss including its own weight.
" W_P = Total normal wind pressure acting on one side of one truss.
" P = Total stress required.
Then P = (W_D × dead load coefficient) + (W_P × wind pressure coefficient).
To find the length of any member between points of intersection :—
Multiply the span by the length coefficient for the member required.
The members are lettered according to Bow's notation. See notes, page 220.

RIDGED ROOF TRUSSES.

Rise of Rafter = 1/4th Span.
" Main Tie = 1 in 15.

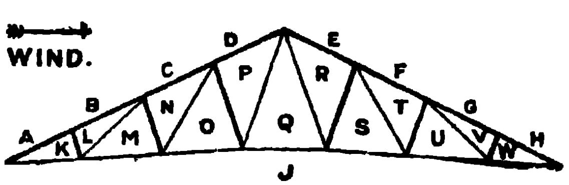


Fig. 7*a*.

Member.	Stress Coefficients.				Length Coefficient.
	Dead Load.		Wind Pressure.		
	Compression.	Tension.	Compression.	Tension.	
A — K	1·13		1·34		·140
H — W	1·13		·70		·140
B — L	1·09		1·38		·140
G — V	1·09		·70		·140
C — N	·90		1·09		·140
F — T	·90		·70		·140
D — P	·72		·82		·140
E — R	·72		·70		·140
K — L	·11		·25		·056
V — W	·11		·00		·056
M — N	·17		·38		·112
T — U	·17		·00		·112
O — P	·22		·51		·168
R — S	·22		·00		·168
J — K		1·01		1·46	·143
J — W		1·01		·48	·143
J — M		·87		1·13	·143
J — U		·87		·48	·143
J — O		·72		·81	·143
J — S		·72		·48	·143
J — Q		·57		·47	·143
L — M		·16		·36	·158
U — V		·16		·00	·158
N — O		·19		·43	·191
S — T		·19		·00	·191
P — Q		·27		·56	·233
Q — R		·27		·03	·233

Rise of Rafter = 1/3rd Span.
" Main Tie = 1 in 12.

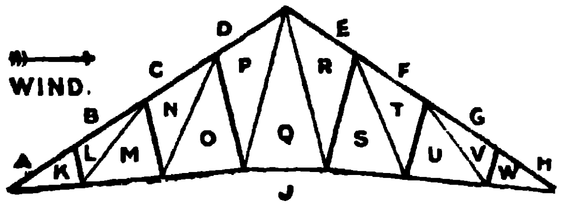


Fig. 7*b*.

Member.	Stress Coefficients.				Length Coefficient.
	Dead Load.		Wind Pressure.		
	Compression	Tension.	Compression.	Tension.	
A — K	·90		·93		·150
H — W	·90		·58		·150
B — L	·87		1·02		·150
G — V	·87		·58		·150
C — N	·72		·84		·150
F — T	·72		·58		·150
D — P	·58		·66		·150
E — R	·58		·58		·150
K — L	·11		·27		·074
V — W	·11		·00		·074
M — N	·17		·40		·147
T — U	·17		·00		·147
O — P	·22		·53		·221
R — S	·22		·00		·221
J — K		·75		1·06	·143
J — W		·75		·29	·143
J — M		·64		·81	·143
J — U		·64		·29	·143
J — O		·54		·55	·143
J — S		·54		·29	·143
J — Q		·42		·28	·143
L — M		·14		·34	·189
U — V		·14		·00	·189
N — O		·18		·44	·244
S — T		·18		·00	·244
P — Q		·27		·58	·307
Q — R		·27		·03	·307

RIDGED ROOF TRUSSES.

PART III.

Explanations of Tables of Coefficients.

Pages 214 to 219.

In roof trusses of the same type as regards the angle of slope of the rafters, and the number and position of the members, *but of any spans*, the stresses in the members due to dead load and wind pressure, and the lengths of the members between points of intersection, are directly proportional to the spans.

Stress Coefficients.

The tables of coefficients for the various types, figs. 1*a* to 7*b*, are calculated on the following assumptions:—

(1). Both shoes fixed, hence vertical reactions due to dead load, and angular reactions due to wind pressure.

(2). Unit span between the points of intersection of the rafters and main ties.

(3). Unit dead load comprising the weights of the truss, purlins and roof covering, uniformly distributed over both rafters and acting in a vertical direction.

(4). Unit wind pressure uniformly distributed over one rafter and acting in a direction normal or at right angles to its surface.

(5) Purlins placed over the points of intersection of the various members with the rafters.

Stress Coefficients.

Each stress coefficient, therefore, is the value of the compressive or tensile stress in the relative member due to dead load or wind pressure for unit loading on unit span.

Length Coefficients.

Similarly, each length coefficient is the length between points of intersection of the relative member for unit span.

Total Stress.

It follows that for any span, any roof covering and any wind pressure required or specified, if the proper tabular stress coefficients for a member are respectively multiplied by the total dead load and total wind pressure acting on the truss, the sum of the two products so ascertained is the total stress in the member, either compression or tension, as the case may be.

Application of Stress Coefficients.

To find the total stress in any member, due to dead load and wind pressure combined:—

L = span between the points of intersection of the rafters and main ties.

W_D = total dead load on one truss, comprising the weights of the truss, purlins and roof coverings.

W_P = total normal wind pressure acting on one side of,one truss.

P = total combined stress required.

Then P = (W_D × dead load coefficient) + (W_P × wind pressure coefficient).

RIDGED ROOF TRUSSES.

Application of Length Coefficients.

To find the length of any member between the points of intersection :—

Multiply the span L by the length coefficient for the member required.

Total Dead Load.

To calculate W_D, the total dead load in lbs. on one truss.

L = span of truss in feet.

C = distance of trusses apart, centre to centre, in feet.

T = approximate weight in lbs. of one truss.

q = weight in lbs. of purlins and covering per square foot of roof surface.

Q = total weight in lbs. of purlins and roof covering supported by one truss.

Weight of Truss.

The following empirical formula (Merriman) gives the approximate weight of a steel truss :—

$$T = \frac{3}{4} C L \left(1 + \frac{L}{10}\right)$$

Weight of Purlins, &c.

Total weight of purlins and roof covering :—

$$Q \begin{cases} = q \times C \times 1{\cdot}12\,L & \text{for rise} = \tfrac{1}{4}\text{th span.} \\ = q \times C \times 1{\cdot}2\,L & \text{" " } = \tfrac{1}{3}\text{rd "} \end{cases}$$

Total Dead Load.

Total dead load, $W_D = T + Q$.

Wind Pressure.

To calculate W_P the total wind pressure in lbs. on one truss: p_n = normal wind pressure in lbs. per square foot of roof surface. See Alignment Chart, page 227.

$$W_P \begin{cases} = p_n \times C \times 0{\cdot}56\,L & \text{for rise} = \tfrac{1}{4}\text{th span.} \\ = p_n \times C \times 0{\cdot}6\,L & \text{" " } = \tfrac{1}{3}\text{rd "} \end{cases}$$

RIDGED ROOF TRUSSES.

Diagrams.

In the diagrams Figs. 1*a* to 7*b* compression members are indicated by heavy lines, and tension members by light lines.

The diagrams are lettered according to Bow's notation, each member being designated by the letters on each side of it.

In order to show the distribution of the stresses due to the wind pressure acting on one side of a truss only, coefficients are given for the complete truss, the horizontal direction of the wind being indicated on each diagram by an arrow.

As the wind may act alternately on either side of a truss, the corresponding members on the windward and lee sides must each be designed for the greater stresses.

The greater stresses generally occur on the windward side, but the exception of the king rod trusses, Figs. 1*a* to 3*b*, may be noted. In each of these trusses the rafter or portion of the rafter next to the apex on the lee side has a greater compressive stress due to wind pressure than the corresponding windward member. These greater stress coefficients for the lee side are printed in prominent type.

Design.

For roof trusses of spans up to 60 feet the rafters are usually designed for the maximum stress in the portion next the shoe, the required section being continued to the apex in one length.

RIDGED ROOF TRUSSES.

Design. Special calculations should be made if the span is greater than 60 feet.

Should the purlins not be placed over the points of intersection of the various members with the rafters, the tabular stress coefficients are not applicable, as non-uniform distribution of the loading may result, and bending stresses are produced in the rafters.

Approximate Weights of Roof Coverings.

	Per Sup. Foot.
Asphalte. For each ½ inch of thickness, ...	6 to 6½ lbs.
Boarding. 1 inch thick, ...	3 to 3½ "
Galvanized Corrugated Sheeting, including taps and bolts. 18 gauge, ...	3 "
" 20 "	2½ "
" 22 "	2 "
Glass. ¼ inch thick, ...	3½ "
Glazing bars (metal), ...	1½ to 3 "
(The lower weight is for purlins spaced about 6 feet apart, and the higher weight for purlins spaced about 10 feet apart.)	
Lead, laid complete including rolls, ...	5½ to 8½ lbs.
(The lower weight is for 5 lb. lead and the higher weight for 7 lb. lead.)	
Plaster ceiling, 1 inch thick, ...	9 lbs.
Slates, including nails, ...	8 to 8½ "
Steel purlins, ...	1½ to 4 "

Weights of the actual sections of steel purlins should be calculated.

WIND PRESSURE.

Relation between Pressure and Velocity.

Experiments conducted at the British National Physical Laboratory and also at the Eiffel Tower, Paris, show that the wind pressure per square foot on square flat surfaces from 10 to 100 square feet in extent is 0·0032 times the square of the wind velocity in miles per hour.

Highest Recorded Velocity.

In the United States of America the highest wind velocity observed for a period of five minutes was 102 miles per hour at St. Paul, Minnesota (*U.S. Weather Bureau Records*).

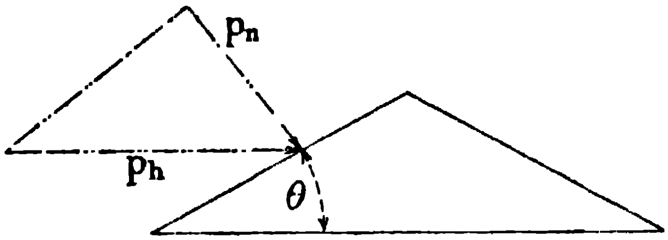
By the Beaufort Scale, a velocity of 56 miles per hour constitutes a strong gale.

From the above it appears that the maximum horizontal wind pressure of 40 lbs. per square foot of exposed vertical surface, as usually assumed in this country, is ample. This pressure corresponds approximately to a velocity of 112 miles per hour.

Normal Wind Pressure.

As fluid pressure is always exerted at right angles to the surface upon which it acts, the corresponding normal pressure calculated by the following formula, or, more conveniently taken from the Alignment Chart, is employed to determine the forces due to wind acting upon the inclined surface of a roof.

WIND PRESSURE—ALIGNMENT CHART.



θ = inclination of roof to the horizontal in degrees.

p_h = assumed or specified intensity of horizontal wind pressure in lbs. per square foot of projected vertical surface.

p_n = by formula, intensity of wind pressure in lbs. per square foot of sloping surface, acting normally or at right angles to the slope.

$$p_n = p_h \frac{2 \sin. \theta}{1 + \sin.^2 \theta}$$

This formula which is considered to be the most reliable for the determination of p_n is due to Duchemin.

Alignment Chart.

For any value of p_h (horizontal wind pressure) between 30 and 50 lbs. per square foot, the Alignment Chart on opposite page gives, without calculation, the value of p_n (the Duchemin normal component) for any angle of inclination between 5° and 60° with the horizontal. Rises corresponding to $\frac{1}{3}$rd, $\frac{1}{4}$th, and $\frac{1}{5}$th of the span are clearly indicated.

Lay straight-edge across the three vertical scales :—

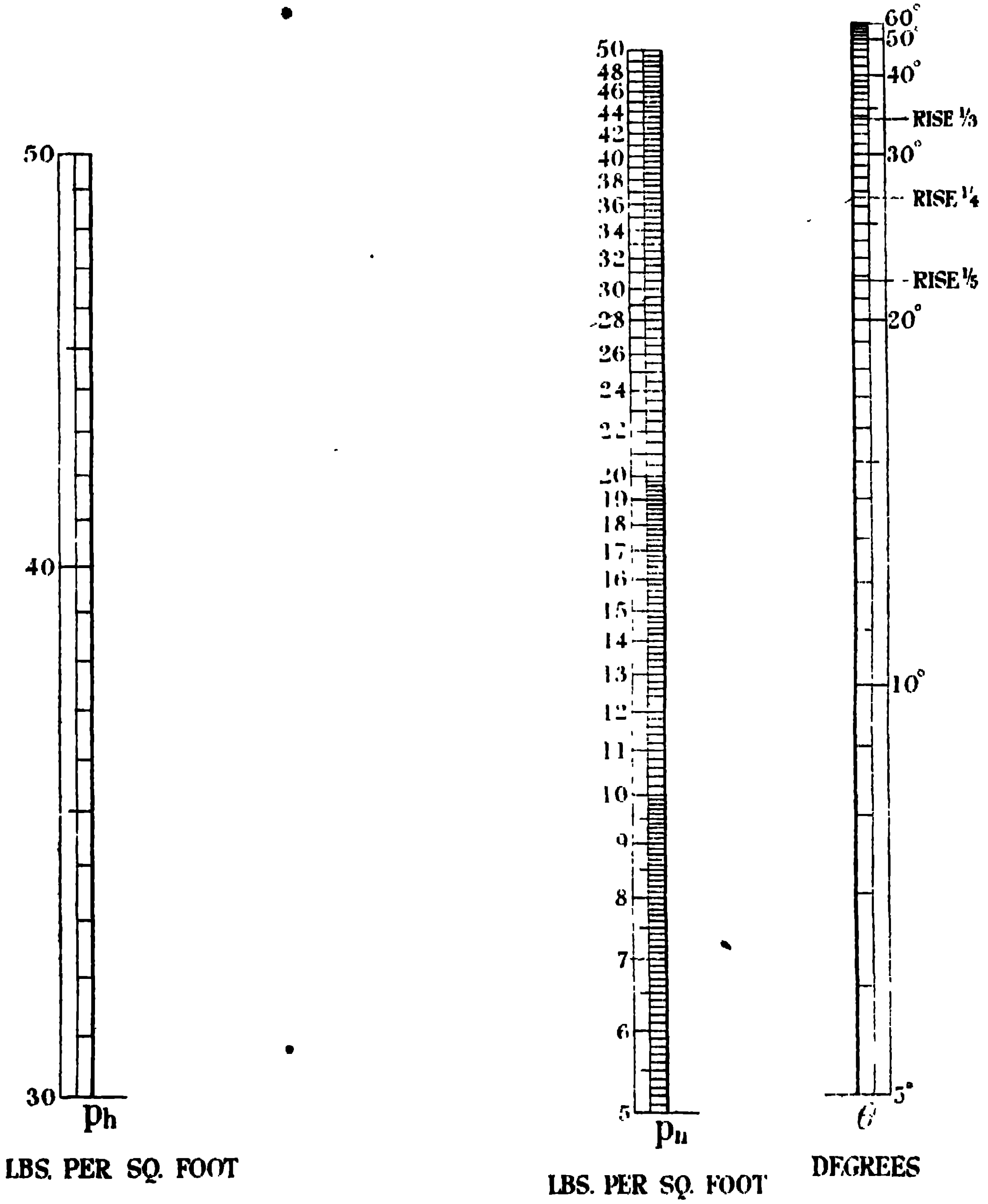
(1). At horizontal wind pressure value on scale p_h.

(2). At angle of inclination or rise on scale θ.

(3). Read value of normal component of wind pressure in lbs. per square foot on scale p_n.

Normal Wind Pressures. **Duchemin Formula.**

ALIGNMENT CHART.



RIDGED ROOF TRUSSES.

Example. The following example illustrates the application of the Strength and Length coefficients, the formulæ, and the Alignment Chart:—

Span of Roof Truss, L = 30 feet.
Centres of Trusses, C = 10 "
Rise = $\frac{1}{4}$th span.
Type, Fig. 3a.
Covering: 18 gauge galvanized corrugated sheeting on steel purlins.
Horizontal Wind Pressure, p_h = 40 lbs. per square foot.

Dead Load W_D.

T = Approximate weight of truss in lbs.

$$= \frac{3 \times 10 \times 30}{4}\left(1 + \frac{30}{10}\right) = 900 \text{ lbs.}$$

Purlins, cleats and bolts = 2 lbs. per super foot.
Sheeting and fittings = 3 " " " "
q = 5 " " " "

Q = Approximate weight of purlins and covering supported by one truss.

$= 5 \times 10 \times 1{\cdot}12 \times 30 = 1680$ lbs.

$\therefore W_D = T + Q = 900 + 1680 = 2580$ lbs.

Wind Pressure W_P—(see Alignment Chart, p. 227).

With straight-edge join 40 lbs. on scale p_h with rise $\frac{1}{4}$th on scale θ degrees.

On centre scale p_n read 29·8 lbs. as the value of the

Example. normal wind pressure per square foot of exposed roof surface.

(This operation is indicated on the chart by a dotted line).

✓$W_{P.} = 29{\cdot}8 \times 10 \times 0{\cdot}56 \times 30 = 5006$ lbs.

Stresses in Members.—(See Tables, pages 214 to 219).

Member.	Dead Load.			Wind Pressure.			Total Stress in Tons.		Length.	
	Dead Load Stress Coefficient.	Stress in Tons = Coeff. × $\frac{2580}{2240}$		Wind Pressure Stress Coefficient.	Stress in Tons = Coeff. × $\frac{5006}{2240}$				Length. Coefficient.	Length in Feet = Coeff. × L.
		Compression.	Tension		Compression.	Tension	Compression	Tension		
A — H	1·080	1·24		1·251	2·80		4·04		·186	5·6
H — J	·165	·19		·368	·82		1·01		·107	3·2
K — L	·248	·28		·551	1·23		1·51		·213	6·4
G — H	·968		1·12	1·356		3·03		4·15		
J — K	·132		·15	·296		·66		·81		
L — M	·412		·47	·437		·97		1·44		

The stresses in this example are calculated for the principal members on the windward side only, as in practice members B-J, C-L, D-M, E-O and F-P would be made of the same section as A-H the portion of the rafter having maximum stress, and similarly G-K, G-N, and G-P would be made of the same section as G-H. For designing it is only necessary to know the lengths of the compression members between their points of intersection.

Minimum Sections. The minimum size of angle or tee used in roof trusses should be 2″ × 2″ × ¼″ and the minimum size of flat, 2″ × ¼″. In designing ties allow for loss of area due to holing.

RIDGED ROOF TRUSSES.

References.

For detailed weights of galvanised corrugated sheets,
sizes of corrugations, &c., - - - See Part IV.
For angles and tees as purlins, - - " " I.
" " " struts (flat ends), " " II.
" " " " (free "), See notes, Part II.
" typical details, - - - - See " V.

Gutters and Downpipes.

Definite reliable data for proportioning gutters and downpipes is lacking. The recommendations, &c., of some authorities are noted as follows:—

British Practice.

> "Rain-water or downpipes should have a bore or internal area of at least 1 square inch for every 60 super. feet of roof surface in temperate climates. They should be placed not more than 20 feet apart to allow of sufficient fall in the eaves gutters, which should be increased in size if the downpipes are further apart. Eaves gutters should never be less in width than twice the internal diameter of the downpipe; more would be an advantage." (Hurst.)

American Practice.

> "The practice among American architects is to provide about 1 square inch of conductor area for each 75 square feet of roof surface; no conductors less than 2 inches in diameter being used in any case." (Ketchum).

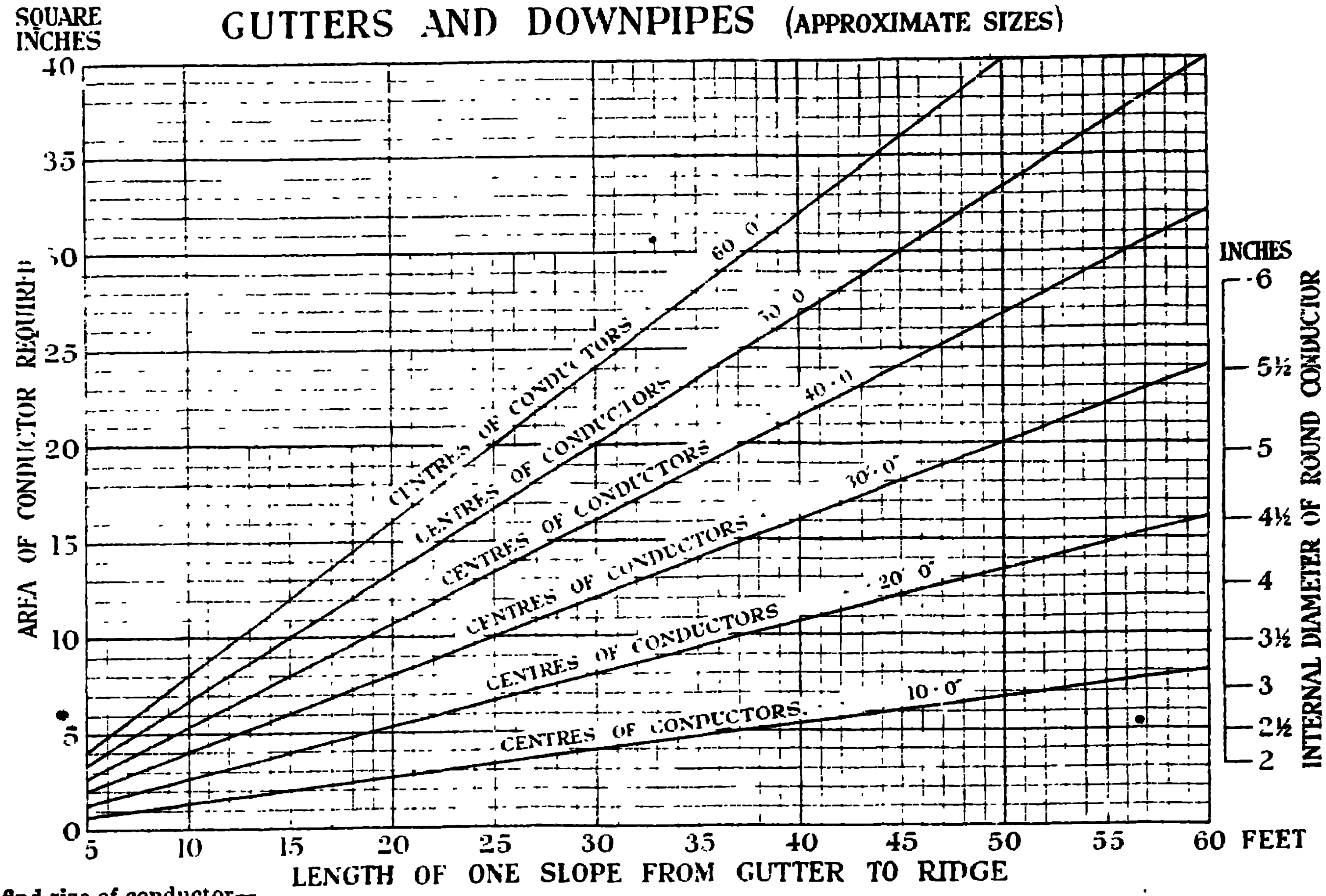
American Bridge Company Specifications.

Span of Roof.	Gutter.	Conductor.
Up to 50 feet.	6 inches.	4 inches every 40 feet.
50 to 70 "	7 "	5 " " 40 "
70 to 100 "	8 "	5 " " 40 "

Diagram.

The diagram on opposite page is based on the practice of allowing one square inch of downpipe area for each 75 square feet of roof surface. Equivalent areas for rectangular pipes or gutters may be substituted, note being taken of commercial sizes.

GUTTERS AND DOWNPIPES (APPROXIMATE SIZES)



To find size of conductor—

(1) Ascertain length of one slope of roof from gutter to ridge. (See "Length Coefficients," pages 214 to 219).

(2) Find intersection of vertical line indicating length of slope, with the diagonal indicating centres of conductors.

(3) Follow along horizontal line from this point and read required area of conductor on scale at left-hand margin.

The nearest diameter of round conductor to give this area can be read above the horizontal line on scale at right-hand margin.

Note.—Half-round gutters should never be less in width than twice the internal diameter of the conductors.

PART IV.

GENERAL.

TABULAR CONDITIONS,
DEFINITIONS,
LOADS,
APPLICATIONS
OF THE
TABLES,
FOUNDATIONS,
PROPERTIES,
WEIGHTS,
AREAS,
DIMENSIONS,
MATHEMATICAL TABLES.

CONTENTS OF PART IV.

PAGE
SPECIAL FEATURES, - - - - - - - 238
TABULAR CONDITIONS, - - - - - - 239
DEFINITIONS AND STATICS, - - - - - 240
NOTATION, - - - - - - - - - - 246
ECONOMICAL CONSIDERATIONS, - - - - 246

LOADS—

Calculation of, - - - - - - - - 248
Due to brick walls, - - - - - - 250
Weight of materials, - - - - - 251
SECTIONS, selection of, from tables, - - - 252
FACTOR OF SAFETY AND WORKING STRESS, 253

BEAMS—

Variations of tabular conditions, - - 253
Lateral support, - - - - - - 256
BENDING MOMENT AND MOMENT OF RESISTANCE, 257

FORMULÆ AND DIAGRAMS—

Reactions, - - - - - - - - 258
Vertical shears, - - - - - - 258
Bending moments, - - - - - - 258
MODULUS OF SECTION, - - - - - - 264
DEFLECTION, - - - - - - - - 265
WEB BUCKLING, - - - - - - - 271
STIFFENERS,* - - - - - - - - 274
PARALLEL JOISTS AND SEPARATORS, - - - 275
RIVET PITCH, - - - - - - - - 275
FLANGE PLATES, curtailment of, - - - - 276
BEARING PLATES, - - - - - - - 278

CONTENTS OF PART IV—(*continued*).

STANCHIONS—

PAGE
Variations of tabular conditions, - - - 279

ECCENTRIC LOADING—

Location of centre of application, - - 280
General formula, - - - - - - 282
Caps, solid round steel stanchions, - - 284
FORMULÆ FOR LATTICING, - - - - - 284
FOUNDATIONS, - - - - - - - - - 288

SAFE PRESSURES ON— - - - - - - -

Various soils, - - - - - - - 289
Concrete, - - - - - - - - 289
Masonry, - - - - - - - 289
STEEL GRILLAGES, - - - - - - - 289

OVERHEAD TRAVELLING CRANES—

Approximate particulars, - - - - - 293
Maximum bending moment, - - - 295
Dynamic effect, - - - - - - 295
Equivalent static load, - - - - - 296
Variable working stress, - - - - - 296
Lateral forces, - - - - - - - 296

STANCHIONS SUPPORTING—

Maximum load, - - - - - - 296
Eccentric loading, - - - - - - 296
Wind pressure, - - - - - - 297

PROPERTIES—

Tabulated formulæ, - - - - - - 298
General formulæ, - - - - - - 303
Compound sections, - - - - - - 304
Deductions for rivet holes, - - - 306

MISCELLANEOUS TABLES—

BOLTS AND RIVETS—

Shearing and bearing values, - - - 308
Weights (bolts), - - - - - - 310
Standard sizes (bolts), - - - - - 312
Lewis bolts, - - - - - - - 312

CONTENTS OF PART IV—(*continued*).

MISCELLANEOUS TABLES—*continued.*

PAGE

Gas Tubing, - - - - - - - - 312
Coupling Boxes, - - - - - - - 313
Washers, - - - - - - - - 313
Rivets, weights, - - - - - - - 314
" lengths, - - - - - - - 315
Corrugated Sheets, - - - - - - 316
Fittings for " - - - - - - 316
Cast Iron Separators, - - - - - - 317
Angles, areas, - - - - - - - 318
" weights, - - - - - - - 319
Flats, areas, - - - - - - - - 320
" weights, - - - - - - - 321
Squares and Rounds, weights and areas, - 324

MOMENTS OF INERTIA—

" " plates, - - - 325
" " joists, net, - - 325
" " channels, net, - - 325
" " rectangles, - - 326

BRIDGE RAILS, - - - - - - - 328

MATHEMATICAL TABLES—

Trigonometrical Formulæ, - - - - - 330
" Functions, - - - - - 331
Logs and Anti-Logs, - - - - - - 332
Sines, Cosines, Tangents, - - - - - 336
Cosecants, Secants, Cotangents, - - - 342
Squares, Square Roots, - - - - - 348
Cubes, - - - - - - - - - - 354
Circumferences of Circles, - - - - - 360
Areas of Circles, - - - - - - 362
Explanatory Notes, - - - - - - 364
Decimals of an Inch, - - - - - - 369
" a Foot, - - - - - - 370
Weights and Measures,
British and Metric, - - - - - - 372
Metric Equivalents, - - - - - - 376

PART IV.—GENERAL.

The utility of this handbook depends largely on the extent to which by a proper use of the tables tedious calculations from first principles are eliminated and the problem of design is reduced to the comparatively simple operation of making an appropriate selection from the number of suitable sections available.

The various notes have been written to explain as fully and as clearly as possible not only the direct applications of the tabular values, but also the methods by which these can be adapted to suit variations of stress, load, support, deflection, and other conditions ordinarily met with in practice.

Parts I., II., III., and V. are each intended to treat of one subject only, the notes to these Parts being confined as strictly as possible to matter directly applicable to the particular tables.

This Part, on the contrary, as the sub-title of "General" indicates, includes all matter applicable to variations of the tabular conditions in addition to useful data, general formulæ, and mathematical tables purposely omitted from the other parts of the book.

The contents of the book generally are intended to apply to structural steelwork in buildings and all forms of construction of a similar nature on which the principal loads are static.

Notwithstanding this distinction certain of the notes and formulæ are of general application, as are the tabulated properties, with the exception of the "Maximum moments of resistance in foot tons," pages 60-67, Part I., which are based on an extreme fibre stress of 7·5 tons per square inch.

Attention is directed to the following features:—

The arrangement of the overall dimensions, safe loads, composition, weight per foot, and properties of each simple and compound section on the corresponding lines of two facing pages.

The indication of web buckling, deflection, and rivet pitch limitations by the free use of zigzag lines and italics.

The tables of minimum spans in feet for various rivet pitches.

The tables of compound girders arranged in descending order of carrying capacity.

The tables of safe loads on steel joists embedded in concrete.

The treatment of stanchions by the Moncrieff formulæ for the practical condition of both ends flat.

The stanchion eccentricity coefficients relative to the axes of least and greatest radii of gyration, and the treatment of eccentric loading by means of these.

The alignment charts for the rapid approximation of the safe loads, &c., on stanchions, and of the intensities of normal wind pressures.

The material of each section is structural mild steel having an ultimate tensile strength of 28 to 33 tons per square inch, in accordance with the specification of the Engineering Standards Committee.

The tabulated loads are based on the undernoted conditions.

PART I.—BEAMS.

(*a*) Static loading uniformly distributed over the entire length of the effective span.
(*b*) The inclusion of the weight of the beam in the load.
(*c*) Each end of the beam being simply supported, not fixed.
(*d*) The laterally unsupported length of the compression flange not exceeding 30 times its breadth.

Safe loads. Additional condition.

(*e*) A working tensile or compressive stress of 7·5 tons per square inch at the extreme fibres, corresponding to a factor of safety of four.

PART II.—STANCHIONS.

(*f*) Static concentric loading.
(*g*) Each end of the stanchion being flat.
(*h*) The average working compressive stress per square inch for each ratio of slenderness as determined by the Moncrieff formulæ.

The properties of the simple sections (those of certain angles and tees excepted) have been taken, by permission, from the lists of the Engineering Standards Committee.

These values are for the exact profiles of the British Standard dimensions, accurate allowances having been made for rounded corners, fillets, and tapered flanges.

The angles and tees excepted above are of thicknesses for which properties are not given by the Committee, and these, in addition to the properties of all compound sections, have been calculated by the technical department of the Company.

DEFINITIONS AND FUNDAMENTAL PRINCIPLES OF STATICS.

Through indiscriminate use in the past, certain terms have acquired ambiguity of meaning.

Present practice tends to eliminate such ambiguity by attaching to each term a particular meaning, as in the following list of definitions, which has been compiled from the leading authorities on the subject.

A Static Load is a stationary load producing no variation of stress intensity, or which is increased gradually from zero up to its maximum amount.

Reactions are the pressures at the points of support, due to the loads. The sum of the reactions is invariably equal to the sum of the loads. For values of reaction, see pages 258-263.

The External Forces which act on a structure are the loads (dead and live) and the reactions due to these.

Stress is the mutual action at the interface between two adjacent portions of a body subjected to the action of external forces.

Tensile Stress or Tension is the stress due to the action of two external forces tending to pull the molecules of a body apart.

Compressive Stress or Compression is the stress due to the action of two external forces tending to push the molecules of a body together.

Shearing Stress or Shear is the stress due to the action of two equal and opposite parallel external forces, tending to make the molecules at two adjoining planes of a body slide past one another.

Stresses and Forces are measured in tons or pounds.

Unit Stress is a total stress of one ton or one pound.

Unital Stress or stress per unit of area or intensity of stress is the quotient obtained by dividing the total stress developed uniformly over a cross section by the area of the cross section. Unital stress is expressed in tons or lbs. per square foot or per square inch.

Ultimate Strength or Ultimate Stress are interchangeable terms, meaning the maximum unital stress which can be developed in the material before rupture takes place.

Working Stress and Factor of Safety. See page 253.

Stress and Strain. Confliction of meaning has arisen through the frequent use of the terms "stress" and "strain" as if they were synonymous. In present practice, "strain" is held to mean the effect of a "stress," and to avoid confusion, it is suggested that the term "deformation" should be substituted.

DEFINITIONS, ETC.—(*continued*).

Deformation is the amount of the resulting change in bulk or shape of a body subjected to the action of stress. Deformations are measured by linear units and are usually expressed in inches.

An Elastic Deformation is one which disappears entirely on the removal of the external forces causing the stress.

Permanent Set is the deformation which wholly or partially remains on the removal of the external forces causing the stress.

Unital Deformation or deformation per unit of length is the total deformation or change of length divided by the original length.

Elastic Limit. The true elastic limit is the maximum unital stress which can be developed in the material without permanent set resulting.

Hooke's Law states that within the true elastic limit stress is directly proportional to the accompanying deformation.

The Commercial Elastic Limit in Tension is the maximum unital tensile stress developed in the material up to the moment of marked breakdown of the test piece, viz., at the yield point.

The Modulus of Elasticity of the material (Symbol E) is the constant which within the true elastic limit expresses the ratio between unital stress and unital deformation or

$$E = \frac{\text{Unital Stress}}{\text{Unital Deformation}}.$$

It may also be defined as that force which would produce in a bar of one unit of cross section, a deformation equal to its original length, provided that Hooke's law were applicable to all stresses without limit.

In present practice the Symbol E denotes **Young's Modulus** or the **Modulus of Longitudinal Elasticity.** The accepted values of E for mild steel are 12,000 to 13,000 tons per square inch, the lower value being generally used for deflection calculations.

Flexure or Bending is due to the simultaneous action of tension, compression, and shear. It occurs when an external force or combination of forces applied to a member causes the originally straight axis of the member to assume the form of a curve.

Beam is a generic term in statics, applied to a structural member subject to flexure. Beams are ordinarily horizontal members, supporting loads acting vertically.

Members may be subjected to flexure combined with tension or with compression. The main tie of a roof used to support a ceiling, or for lifting loads from a floor is a familiar case of flexure and tension, while rafters supporting intermediate purlins, and stanchions eccentrically loaded or subjected to wind pressure are in a state of flexure and compression.

DEFINITIONS, ETC.—(*continued*).

A Simple Beam is a horizontal member simply supported at the ends, so that all parts have free movement in a vertical plane under the influence of vertical loads.

Distribution of Stress in a flexed or bent beam. On the convex side the fibres are elongated by tension, and on the concave side the fibres are shortened by compression. Simultaneously, shear is taking place between each vertical plane of the member and the one adjoining. As the stresses change in kind, from tension to compression, it follows that at the surface in the depth of the beam where the change in kind of stress takes place, the intensity of stress is zero.

The Neutral Axis is the name given to this surface of zero stress. For a section of mild steel it passes through the centre of gravity or centre of area, as the ultimate tensile and compressive strengths of this material are taken as equal in value. The neutral axis of a symmetrical mild steel section is at the middle of its depth.

Extreme Fibres are the fibres of infinitesimal thickness at the surface or edge of the section most remote from the neutral axis, the distance being measured in a direction perpendicular to the neutral axis.

Extreme Fibre Stress. It can be shown that within the elastic limit, the deformation, and consequently the stress in any fibre is proportional to its distance from the neutral axis, and that the intensity of stress increases as the distance increases. The maximum intensity of stress is reached at the extreme fibres, and therefore the maximum permissible unital stress at the extreme fibres is also the tensile or compressive working stress.

A Stanchion or Strut is a structural member, conventionally vertical and of a height not less than 8 to 10 times its least lateral dimension.

Vertical loading on such a member produces direct or axial compression, accompanied by the development of flexural stresses due to the tendency of the stanchion to fail by buckling or bending in a lateral direction.

The maximum intensity of the compressive stress due to flexure occurs at the extreme fibres of the section on the concave side.

The working stress for a stanchion is therefore the maximum permissible unital stress at the extreme fibres, and is a fraction of the sum of the maximum axial and flexural compressive stresses developed at the point of failure, as determined by a suitable stanchion formula.

Positive and Negative Forces. Retaining the convention that a beam is a horizontal member, loads or external forces acting downwards are taken as negative, and reactions or external forces acting upwards are taken as positive.

The Moment of a Force about any point is the value of the force multiplied by its leverage or distance from the point, measured in a direction perpendicular to the line of action of the force. A moment being a compound quantity is expressed in foot tons or inch tons.

DEFINITIONS, ETC.—(*continued*).

The Laws of Equilibrium assert that for a system of vertical forces acting in one plane—

(*a*) the algebraic sum of all the vertical forces must equal zero.
(*b*) the algebraic sum of the moments of all the vertical forces must equal zero.

In other words, as the algebraic sum is the difference of positive and negative values, it is apparent that the negative, or downward forces, and the positive, or upward forces, and their respective moments must be equal and opposite to each other.

End Reactions. By the first of the laws of equilibrium the sum of the reactions must equal the sum of the loads.

In a simple beam, each end reaction will equal ½ the sum of the loads for the conditions of:—

(*a*) Loading uniformly distributed.
(*b*) A single load concentrated at the centre of the span.
(*c*) Any system of concentrated loads in pairs of equal value or partially distributed loads of equal value disposed symmetrically with reference to the points of support.

By the second of the laws of equilibrium the sum of the moments of the reactions must equal the sum of the moments of the loads.

This is the general statement from which the values of the reactions at each support for any symmetrical or unsymmetrical system of loading on a simple beam may be ascertained.

See pages 258-263 for formulæ and numerical example.

SHEARING FORCE AND BENDING MOMENT.

NOTE.—As a matter of convenience, in the immediately following paragraphs relating to shear and bending moment, the left hand support is considered to be the point of origin.

Vertical Shear is the measure of the shearing tendency which occurs at every imaginary transverse section in a beam. The vertical shear at any such transverse section is equal to the algebraic sum of all the external forces to the left of the section, and is expressed in tons or lbs.

Vertical shears are termed positive or negative according to the relative values of the loads and reactions to the left of the imaginary transverse section.

The Maximum Positive Vertical Shear in a simple beam occurs over the left hand support and is equal in amount to the left hand reaction. Similarly the maximum negative vertical shear occurs over the right hand support and is equal in amount to the right hand reaction

Zero Point. It follows that the vertical shear must pass through zero at the intermediate point where the sign of shear changes from positive to negative.

DEFINITIONS, ETC.—(*continued*).

Location of Zero Point. This point may be located for any system of static loading by the following method:—

Beginning at the left hand support, add the successive values of the loads to the right until their sum exceeds the value of the left hand reaction. The point at which the vertical shear passes through zero occurs immediately under the load causing the excess.

If the loading is uniformly distributed or symmetrically disposed, relative to the supports, the point of zero shear is at the centre of the span.

See pages 258-263 for formulæ and diagrams.

The Bending Moment at any imaginary transverse section of a beam is the measure of the action of the external forces tending to cause rotation about the section. The bending moment at any such section is equal to the algebraic sum of the moments of all the external forces to the left of the section. It is expressed in inch tons or foot tons. Moments to the left of the section acting upwards are taken as positive, and these to the left of the section acting downwards are taken as negative.

The Maximum Bending Moment in a simple beam supporting any system of static loading, occurs at the point at which the vertical shear passes through zero.

If the loading is uniformly distributed or symmetrically disposed relative to the supports, the maximum bending moment occurs at the centre of the span.

In a cantilever the maximum bending moment occurs at the supports irrespective of the position of the loads.

Minimum Bending Moment. In a simple beam the bending moment at the supports is zero.

See pages 258-263 for formulæ and diagrams.

Deflection is the measure of the vertical displacement of any point of a loaded beam from its position when the beam is unloaded. Deflection is expressed in inches.

In steel structural work for buildings it is the practice to use formulæ for the calculation of the maximum deflection due to the flexural stresses only. Deflection due to shear, which amounts to about 3°/ₒ of the total for ordinary structural sections is neglected.

The Maximum Deflection in the case of a simply supported beam may be taken as at the point of maximum bending moment.

The Investigation of the Strength of Beams is governed by the three following laws:—

(*a*) The sum of all tensile stresses must equal the sum of all compressive stresses.

(*b*) The resisting shear must equal the vertical shear.

(*c*) The moment of resistance must equal the bending moment.

DEFINITIONS, ETC.—(*continued*).

or summarized,

(*d*) In order that equilibrium may obtain, the external forces acting at any imaginary transverse section of a beam must be equalled by the internal resisting forces, and their moments must also be equal.

The Moment of Resistance at any imaginary transverse section of a beam is the measure of the action of the internal forces which resist the rotary tendency caused by the external forces. The moment of resistance at any such section is equal to the sum of the moments of all the tensile and compressive stresses in the material at the section, acting as a couple. It is usually expressed in inch-tons, but if equated to the bending moment in foot-tons, it must be expressed in the same terms as the latter. The moment of resistance of a section is most conveniently derived from the corresponding tabular value of moment of inertia, as the direct determination involves the integral calculus.

The maximum moment of resistance may be taken as the criterion of the strength of a beam to resist flexure.

Properties of a section are values dependent upon its profile or shape only, and which form a basis for the determination of its strength. All the tabulated properties are calculated with reference to central axes.

A Central Axis is one which passes through the centre of gravity or, more correctly, through the centre of area of the figure or profile of the section.

Central Axis and Neutral Axis coincide for a section of mild steel, this material being taken as of equal strength in tension and in compression. The former term is generally used in connection with values such as properties involving areas or linear dimensions only, the latter term is used in connection with values such as moment of resistance involving stress.

A Principal Axis is a central axis with reference to which the moment of inertia is maximum or minimum.

An Axis of Symmetry is a principal central axis dividing the profile of a section into two portions of equal area and shape.

An Asymmetrical Axis is a central axis which does not divide the profile symmetrically. It may or may not be a principal axis.

The Ellipse of Inertia is an ellipse constructed to show the relations between the moments of inertia and radii of gyration for different central axes.

Moment of Inertia is the basis property for taking account of the fact that the moment of stress varies as the square of the distance from the neutral axis. If it is supposed that a transverse section of a beam is divided into elementary areas, then the moment of inertia is equal to the

DEFINITIONS, ETC.—(*continued*).

sum of the products obtained by multiplying each elementary area by the square of its perpendicular distance from the central axis. It is expressed in inches.^{4}

Modulus of Section at any imaginary transverse section of a beam is the measure of the resisting moment of the beam at the section. It is expressed in inches.^{3}

The maximum modulus of section is largely used as a direct basis of *comparison* of the strength of a beam to resist flexure, being equal to the moment of resistance for an extreme fibre stress of one ton per square inch.

Modulus of Section is sometimes termed Moment of Resistance, but this is apt to lead to confusion when practical working stresses have to be taken into account.

Radius of Gyration is generally used as the basis of comparison of the strength of a stanchion to resist buckling or bending. It is a linear dimension expressed in inches.

It is equal to the perpendicular distance from the central axis to such point as, if all the area were there concentrated, the moment of inertia would be the same.

The terms used in this book have the foregoing definite meanings unless where specifically qualified by the context.

NOTATION.

The same notation is used throughout the book.

The same symbol is used on occasion to denote different quantities when these cannot possibly be mistaken for each other.

Subscripts denote values relative to particular axes, or particular applications of a general symbol.

For convenience of reference, the less familiar symbols and their meanings are repeated where necessary.

ECONOMICAL CONSIDERATIONS AFFECTING DESIGN.

The general problem of steelwork design is to provide in a structure a sufficient area of material distributed in such a manner that the external forces will be safely resisted by the internal forces.

The correct theoretical solution will necessarily be qualified by the important practical considerations of the location of the principal members, available commercial sizes, cost of manufacture, and time for completion.

It should be borne in mind that sections of the exact areas required are not always procurable, that some forms of material are cheaper and more readily obtainable than others, and that material is cheaper than workmanship.

ECONOMICAL CONSIDERATIONS—(*continued*).

It follows that the design in which the area of each member is reduced to the lowest possible limits consistent with safety, may be the most correct theoretically, but it may also be very costly to produce.

On the other hand, the best design is that which accomplishes the object in view in the most economical fashion, and which may be executed in the shortest period of time.

These desiderata are attained by aiming at simplicity of workmanship throughout, by avoiding complicated forms of lattice work and connections, and by using only such sections as are readily obtainable, preferably those which are always in stock. See page 6.

The number and positions of the stanchions, beams, and roof trusses forming a steel structure must depend upon the scheme of architecture and the purpose for which the building is intended.

No definite rules can be given, but where no restrictions are imposed the following may be noted as tending to economy in the use of steelwork.

Manufacturing and erection costs are kept low by the adoption of a convenient unit such as 15 feet by 15 feet for the centres of stanchions and spans of main beams, and adhering throughout to the unit arrangement decided upon.

By this means stanchions, beams, and connections may be standardised and the minimum number of drawings and templates are required.

BEAMS.

For a given load beams of short span are relatively more economical per unit of length than beams of long span.

This will generally hold good even taking the necessary supports into account, especially if the latter are steel stanchions, except in the case of a moving load which may act at its full value on each support irrespective of spacing.

For usual conditions of loading, the most economical beam is the deepest available steel joist or compound girder of the required strength. It may even be considerably in excess of the required strength and remain less costly than a shallower section. See Part I., page 109.

For this reason, under certain circumstances, it may be cheaper to increase the overall height of a floor or of a building than to restrict the beam depth.

This applies particularly to large steel framed buildings of the warehouse class having thin external walls and few, if any, important internal partitions.

ECONOMICAL CONSIDERATIONS—(*continued*).

Beams of unsymmetrical section are not relatively economical.

The dotted and full zigzag lines and the italics of the beam tables, Part I., may be said to mark the economical limits of the various sections and types.

By choosing sections within those limits the additional costs of stiffeners and special rivet pitches are avoided and undue deflection prevented.

Special deflection considerations are treated later.

STANCHIONS.

The full zigzag lines of the stanchion tables, Part II., mark the economical limits of height. To the right of these lines the loads for each increase of height decrease more rapidly than do these to the left.

For a series of superimposed stanchions an economical method is to select a simple joist section for the topmost storey, and retaining the same joist section to the foundation, add the increase of area required at each succeeding lower floor level by means of plates riveted to each flange.

Eccentric loading is costly and should be avoided if possible.

LOADS.

The calculation of the value and condition of the load to be supported is in every case a preliminary necessary to the design or selection of a structural member.

This is a matter of great importance, as the efficiency and economy of a structure must depend to a very large extent on the degree of approximation of the assumed load values, to those actually realised in practice.

Consider a building of steel skeleton construction.

The necessary load calculations are accomplished most conveniently in the reverse order of the building operations.

Commence at the roof or highest portion of the structure, and work down through each floor in succession.

At each level take the secondary members such as flooring beams before the main girders, and main girders before stanchions.

Note the total load value transmitted to each stanchion, at each tier, and finally arrive at the total load on each foundation.

CONDITIONS OF LOADING.

On beams the loading may be—

(*a*) Uniformly distributed over entire length of effective span.
(*b*) Concentrated at one or more points.
(*c*) Unequally distributed.
(*d*) Any combination of *a*, *b*, and *c*.

LOADS—(*continued*).

On stanchions the loading may be—

(*e*) Concentric.
(*f*) Balanced.
(*g*) Eccentric.
(*h*) Any combination of *e*, *f*, and *g*.

A structure is designed to support both dead and alive loads.

The total dead load comprises the weight of the structure itself, and all permanent loads, *i.e.*, roof coverings, floors, partitions, walls, and heavy fixtures.

The total live load comprises the weight of all variable or moveable loads, *i.e.*, wind pressure, snow, water in tanks, people, furniture, goods, or merchandise.

Machinery, overhead travelling cranes, &c., require special consideration.

Dead and live loads should be calculated in accordance with the requirements of the local Building Authority.

In the absence of specific regulations, the following rules based on the London County Council (General Powers) Act, 1909, may be followed.

(1) **The dead load** shall consist of the actual weight of walls, floors, roofs, partitions, and all other permanent construction.

(2) **The live or superimposed load** shall be estimated as equivalent to the following dead load.

FLOORS.

Description of Building.	Load in lbs. per square foot of floor area.
Human habitation or domestic building, -	70
Office, counting-house or similar building,	100
Workshop or retail shop, - - - -	112
Building of the warehouse class, - -	Not less than 224.

(*Table continued overleaf*).

LOADS—(*continued*).

ROOFS.

Description.	Load in lbs. per square foot of roof area including wind pressure.
Angle of inclination to the horizontal greater than 20 degrees, - - - - - -	28 Measured on slope.
All other roofs, - - - - - - -	56 Measured horizontally.

(3) If the superimposed load is to exceed that specified for its class, the excess shall be provided for.

(4) All buildings shall be designed to resist safely a horizontal wind pressure of not less than 30 lbs. per square foot of the upper two-thirds of the exposed surface.

BEAMS SUPPORTING BRICK WALLS.

When a beam or girder is used to support a brick wall over an opening, the value of the dead load may vary according to several conditions.

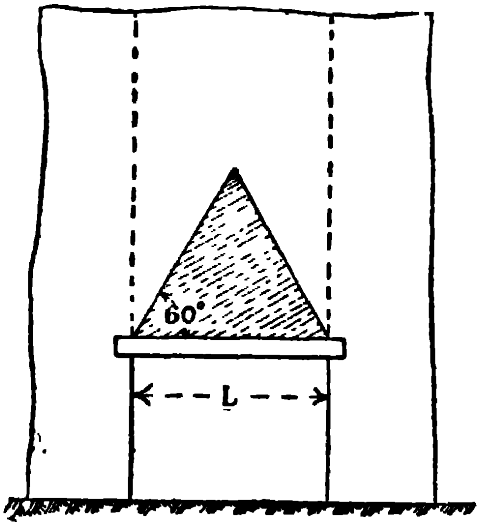


FIG. 1.

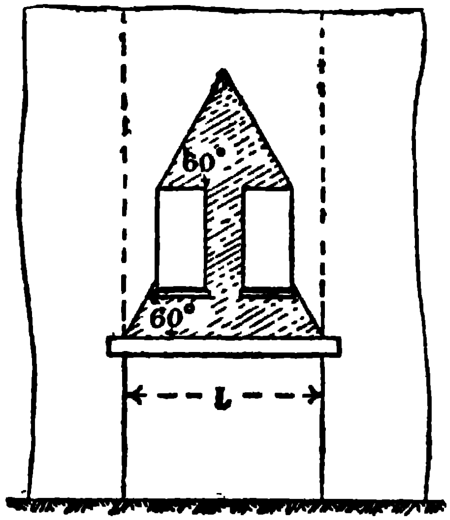


FIG. 2

The usual practice in this country is to take a load uniformly distributed equivalent to the weight of the brickwork enclosed by the equilateral triangle shown in Fig. 1.

If there are windows or other openings in the wall, the usual course is to take the weight of the area of brickwork shown shaded in Fig. 2.

BEAMS SUPPORTING BRICK WALLS—(*continued*).

The load should be taken as equivalent to the whole mass of brickwork enclosed by dotted lines in Figs. 1 and 2 if :—

(*a*) The brickwork is not thoroughly bonded throughout.
(*b*) The breadth of each abutment is less than half the span.
(*c*) Great rigidity is required.

In buildings of steel skeleton construction, the entire weight of the brickwork, terra cotta or other material within the rectangle formed by two stanchions and two beams at succeeding floor levels should be taken as the load on the lower beam.

In every case add the load due to any portion of roof or floor supported.

For permitted ratios of deflection for beams supporting brick walls, see page 271.

WEIGHTS OF MATERIALS.

The following table of average weights of materials has been compiled from various authoritative sources:—

APPROXIMATE WEIGHTS OF MASONRY, TIMBER, METALS, &C.
LBS. PER CUBIC FOOT.

MASONRY.

Asphalte, - - - -	140—150	Concrete, Reinforced, -	150—160
Brickwork pressed, -	130—150	Granite, - - -	140—190
" ordinary, -	110—130	Limestone, Ashlar, -	140—170
" soft, - -	90—100	" , Rubble, -	130—150
Cement (Portland), -	86— 94	Sandstone, - - -	130—150
Concrete, - - - -	110—140	Slate, - - - -	160—180

TIMBER.

Elm, - - - - - -	34—36	Oak (American), - -	48—54
Greenheart, - - - -	60—70	Pitch Pine, - - -	42—48
Jarrah (Wood Paving), -	60—63	Red Pine and Spruce Fir, -	30—44
Larch, - - - - -	31—35	Teak, - - - - -	41—55
Oak (English), - - -	48—60	Yellow Pine (American), -	30—32

METALS AND ALLOYS.

Aluminium, - - -	160—167	Iron, Wrought, - - -	485
Brass, - - - - -	525—530	Lead, - - - - - -	710
Copper, Sheet, - -	548	Steel, Cast, - - - - -	492
" , Wire, - -	555	" , Rolled, - - - -	490
Gunmetal, - - -	528	White Metal, - - - -	456
Iron, Cast, - - -	450	Zinc, - - - - - -	437

(Table continued overleaf.)

WEIGHTS OF MATERIALS—(*continued*)

The following table of average weights of materials has been compiled from various authoritative sources:—

APPROXIMATE WEIGHTS OF MISCELLANEOUS MERCHANDISE
LBS. PER CUBIC FOOT.

Barley,	35— 40	Hay and Straw in Bales,	14—19
Cement in Bags,	84	Leather in Bales,	16—23
Cement in Barrels,	62— 82	Lime in Barrels,	50—60
Coal (Broken),	80— 95	Oats,	25—30
Coke,	40— 50	Paper,	10—64
Corn,	30— 35	Plaster in Barrels,	50—60
Cotton in Bales,	12— 43	Rags in Bales,	7—36
Cotton Goods,	11— 37	Rope,	40—45
Crockery in Crates,	35— 40	Sugar,	45—50
Flour,	40— 45	Wheat,	40—45
Glass,	160—190	Wool in Bales,	5—28
Glass in Boxes,	60	Woollen Goods,	13—22

1 cub. ft. of Fresh Water = 62·5 lbs.
1 gallon " " = 10 "
36 cub. ft. " " = 1 ton.
224 gallons " " = 1 ton.
Weight of Sea Water = 1·026 × Weight of Fresh Water.

SELECTION OF SECTIONS.

Assuming that the value and condition of a load is known, the question of selecting a suitable section from the tables may now be considered.

For the tabular conditions of stress load and support.

BEAMS.—PART I.

A section is suitable as regards flexure, deflection, web buckling, and rivet pitch, provided the tabular safe load for the required span is:—

(*a*) Not less than the actual load.
(*b*) Not printed in italics.
(*c*) Not to the left of a dotted zigzag line.
(*d*) Not to the right of a full zigzag line.

STANCHIONS.—PART II.

A section is suitable as regards strength provided that the tabular load for the required height is:—

(*a*) Not less than the actual concentric load.
(*b*) Not less than the equivalent concentric load value of an actual load eccentric about the axis of least radius of gyration.

FACTOR OF SAFETY AND WORKING STRESS.

The factor of safety is the number by which the ultimate strength of the material must be divided to give the working stress.

The working stress or safe stress is the highest permissible fraction of the ultimate strength determined by practice to give a proper degree of security against the rupture of any portion of the material.

The factor of safety and working stress ensure that the maximum stresses developed in any member must never approach the ultimate strength of the material by making reasonable provision for:—

(*a*) Undiscoverable and unavoidable imperfections of material and workmanship.

(*b*) Deterioration of material due to fatigue or oxidisation.

(*c*) The possibility under unforeseen circumstances of an increase of the amount or change in the nature of the load calculated to be supported.

Usual factors of safety and corresponding working stresses in tons per square inch are:—

Condition of Loading.	Factor of Safety.	Working Stresses.	
		Tension or Compression.	Shear.
For Stationary Loads, - - -	4	7·5	5·5 to 6
For Moving Loads not applied with impact (see also pages 295-296), -	6	5	3·6 to 4
For Temporary Work, - - -	3	10	7·3 to 8

BEAMS. PART I.

Variations of the Tabular Conditions.

Formulæ for Equivalent Tabular Loads.

By means of the following formulæ, equivalent tabular loads may be ascertained for the variations of stress, factor of safety, load and support conditions, ordinarily met with in practice.

As the included weight of the beam is uniformly distributed, the results obtained for concentrated loading are not strictly accurate, but are sufficiently so for practical purposes.

VARIATIONS—(*continued*).

FORMULÆ FOR EQUIVALENT TABULAR LOADS.

SAFE LOAD TABLES.

Description.	Support Condition.	Load Condition.	Equivalent Tabular Load for Extreme Fibre Stress.		Equivalent Tabular Load for Factor of Safety.
			Modified	Tabular	
Beam.	Both ends simply supported.	Loading uniformly distributed.	$\frac{7 \cdot 5\ W}{f}$	W	$\frac{W\ F}{4}$
"	"	Single load at centre of span.	$\frac{15\ W}{f}$	2 W	$\frac{W\ F}{2}$
"	Both ends fixed or encastré.	Loading uniformly distributed.	$\frac{5\ W}{f}$	$\frac{W}{1 \cdot 5}$	$\frac{W\ F}{6}$
"	"	Single load at centre of span.	$\frac{7 \cdot 5\ W}{f}$	W	$\frac{W\ F}{4}$
Cantilever.	One end fixed or encastré.	Loading uniformly distributed.	$\frac{30\ W}{f}$	4 W	W F
"	"	Single load at extreme outer end.	$\frac{60\ W}{f}$	8 W	2 W F

W = actual load in tons. f = extreme fibre stress in tons per square inch.
F = factor of safety.

When the tabular conditions are modified, deflection, web-buckling, and rivet pitch limitations should be noted.

VARIATIONS—(*continued*).

FORMULÆ FOR EQUIVALENT TABULAR LOADS.

BREAKING LOAD TABLES.

Description.	Support Condition.	Load Condition.	Equivalent Tabular Load for		
			Extreme Fibre Stress.		Factor of Safety.
			Modified.	Tabular Breaking.	Modified.
Beam.	Both ends simply supported.	Loading uniformly distributed.	$\frac{30\,W}{f}$	W	W F
"	"	Single load at centre of span.	$\frac{60\,W}{f}$	2 W	2 W F
"	Both ends fixed or encastré.	Loading uniformly distributed.	$\frac{20\,W}{f}$	$\frac{W}{1 \cdot 5}$	$\frac{W\,F}{1 \cdot 5}$
"	"	Single load at centre of span.	$\frac{30\,W}{f}$	W	W F
Cantilever.	One end fixed or encastré.	Loading uniformly distributed.	$\frac{120\,W}{f}$	4 W	4 W F
"	"	Single load at extreme outer end.	$\frac{240\,W}{f}$	8 W	8 W F

W = actual load in tons. f = extreme fibre stress in tons per square inch.
F = factor of safety.

When the tabular conditions are modified, deflection, web-buckling, and rivet pitch limitations should be noted.

VARIATIONS—(*continued*).

FORMULÆ FOR EQUIVALENT TABULAR LOADS.

Examples :—

(*a*) Required a suitable section for a load of 14·08 tons (including weight of beam) distributed uniformly over a span of 12 feet, the extreme fibre stress not to exceed 6 tons per square inch, corresponding to a factor of safety of 5.

The equivalent tabular load W_T to be referred to is :

$$\left.\begin{aligned} W_T &= \frac{7{\cdot}5W}{f} \\ &= \frac{7{\cdot}5 \times 14{\cdot}08}{6} \\ &= 17{\cdot}6 \text{ tons.}\end{aligned}\right\} \text{ or } \left\{\begin{aligned} W_T &= \frac{WF}{4} \\ &= \frac{14{\cdot}08 \times 5}{4} \\ &= 17{\cdot}6 \text{ tons.}\end{aligned}\right.$$

On referring to 17·6 tons in the table on page 16, Part I., it is found that a steel joist 10″ × 6″ × 42 lbs. is suitable.

(*b*) Required a suitable section of tee as a cantilever for a load of ½ ton concentrated at a point 5 feet from the support, the extreme fibre stress not to exceed 10 tons per square inch corresponding to a factor of safety of 3.

The equivalent tabular load W_T to be referred to is :—

$$\left.\begin{aligned} W_T &= \frac{240W}{f} \\ &= \frac{240 \times {\cdot}5}{10} \\ &= 12 \text{ tons.}\end{aligned}\right\} \text{ or } \left\{\begin{aligned} W_T &= 8\,WF \\ &= 8 \times {\cdot}5 \times 3 \\ &= 12 \text{ tons.}\end{aligned}\right.$$

On referring to page 92, Part I., it is found that the tabular loads for 4″ × 5″ × ½″ tee for 5 feet span is 11·9 tons, therefore this section is suitable.

LATERAL SUPPORT.

Experience has shown that the conventional estimate of the strength of a beam without lateral support is somewhat low. This is specially applicable to a steel joist or compound girder, as the solid web assists the tension flange in sustaining the compression flange, and the buckling which would otherwise take place is prevented to a large extent.

It has been proved by experiment that when the laterally unsupported length of a beam becomes 80 times the flange breadth, the normal strength is reduced by about one-third.

Lateral Support—(*continued*).

Should the laterally unsupported length of the compression flange of a beam exceed 30 times its breadth it is recommended by certain authorities that the loading be reduced in the following proportions:—

Distance between Lateral Supports.	Safe Load Uniformly Distributed.
40 times flange width,	$\frac{7}{8}$ tabular load.
50 " " "	$\frac{3}{4}$ " "
60 " " "	$\frac{5}{8}$ " "
70 " " "	$\frac{1}{2}$ " "

These proportions apply also to the equivalent tabular loads found by formulæ, pages 254-255.

In structural steelwork for buildings the expert engineer is permitted a considerable latitude in interpreting the above recommendation.

BENDING MOMENT AND MOMENT OF RESISTANCE.

The law that "for equilibrium the moment of resistance must equal the bending moment," underlies all formulæ for the flexural strength of a beam.

For this reason, when an equivalent tabular load cannot be ascertained immediately by a convenient multiplier (such as 2 for a single concentrated central load), the method adopted by the majority of engineers is to calculate the maximum bending moment due to the system of loading.

Formulæ for the calculation of the maximum bending moment or usual systems of loading are given on the following pages.

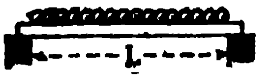
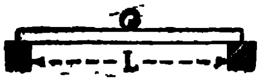
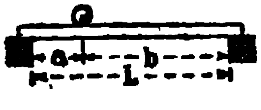
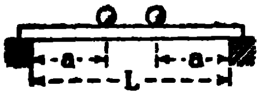
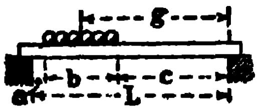
Moment of Resistance Tables. Part I.

If the maximum bending moment in foot tons is known for any system of loading, a suitable section for the tabular extreme fibre stress of 7 5 tons per square inch or factor of safety of 4, may be selected without further calculation by using the tables of "Compound Girders arranged in Descending Order of Carrying Capacity," Part I, pages 60 to 67 inclusive.

The method of using these tables is given in Part I., page 109.

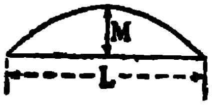
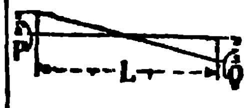
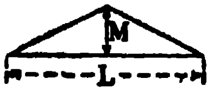
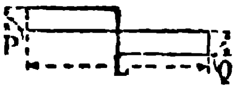
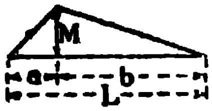
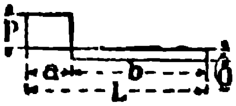
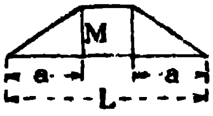
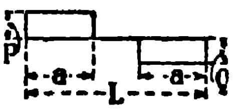
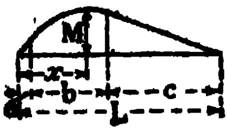
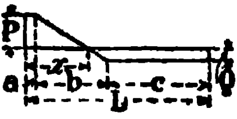
LOAD EQUIVALENTS AND MAXIMUM DEFLECTIONS FOR VARIOUS CONDITIONS OF LOADING.

W_A = Superimposed Load.
W_B = Total Weight of Beam.
L = Effective Span.
I = Moment of Inertia.
E = Modulus of Elasticity.

Condition of Loading.	Safe Load Factor (approx.).	Equivalent Distributed Load including W_B.	Maximum Deflections.	
			Due to Superimposed Load W_A.	Due to Superimposed Load W_A + Weight of Beam W_B.
 (1)	1	$W_A + W_B$	$\frac{5W_A L^3}{384EI}$	$\frac{5(W_A + W_B)L^3}{384EI}$
 (2)	½	$2W_A + W_B$	$\frac{W_A L^3}{48EI}$	$\frac{W_A L^3}{48EI} + \frac{5W_B L^3}{384EI}$
 (3)	$\frac{L^2}{8ab}$	$\frac{4ab(2W_A + W_B)}{L^2}$	$\frac{W_A ab(2L - a)}{9EIL} \times \sqrt{\frac{a(2L - a)}{3}}$	
 (4)	$\frac{L}{4a}$	$\frac{4W_A a}{L} + W_B$	$\frac{W_A a(3L^2 - 4a^2)}{48EI}$	$\frac{W_A a(3L^2 - 4a^2)}{48EI} + \frac{5W_B L^3}{384EI}$
 (5)	$\frac{L^3}{(4bg^2 + 8agL)}$ for $g = \frac{b}{2} + c$	For Symmetrical Sections, Working Stress at 7·5 tons per square inch. E = 12,000 tons per square inch. L in feet. δ = Maximum deflection in inches. K = Coefficient, Part I. Then for Case (1) $\delta = KL^2$ and for case (2) $\delta = KL^2 \div 1{\cdot}25$. Safe Load Factor (approximate). W = Total Load in Tons. W_T = Tabular Load in Tons, Part I. Then $W = W_T \times$ Safe Load Factor.		

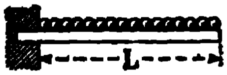
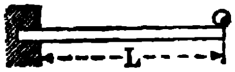
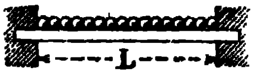
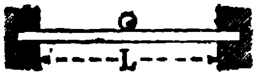
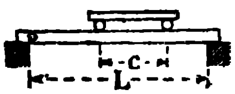
BENDING MOMENTS, REACTIONS AND VERTICAL SHEARS FOR VARIOUS CONDITIONS OF LOADING.

M = Maximum Bending Moment. L = Effective Span.
P = Maximum Positive Shear = Left Hand Reaction.
Q = Maximum Negative Shear = Right Hand Reaction.

Bending Moments.			Reactions and Vertical Shears.		
Diagram.	Maximum due to		Diagram.	Maximum due to	
	W_A only.	$W_A + W_B$		W_A only.	$W_A + W_B$
 (1a)	$M = \frac{W_A L}{8}$	$M = \frac{(W_A + W_B)L}{8}$	 (1b)	$P = \frac{W_A}{2}$ $Q = \frac{W_A}{2}$	$P = \frac{W_A + W_B}{2}$ $Q = \frac{W_A + W_B}{2}$
 (2a)	$M = \frac{W_A L}{4}$	$M = \frac{W_A L}{4} + \frac{W_B L}{8}$	 (2b)	$P = \frac{W_A}{2}$ $Q = \frac{W_A}{2}$	$P = \frac{W_A + W_B}{2}$ $Q = \frac{W_A + W_B}{2}$
 (3a)	$M = \frac{W_A ab}{L}$	$M = \frac{a(2W_A b + W_B L)}{2L} - \frac{W_B a^2}{2L}$	 (3b)	$P = \frac{W_A b}{L}$ $Q = \frac{W_A a}{L}$	$P = \frac{W_A b}{L} + \frac{W_B}{2}$ $Q = \frac{W_A a}{L} + \frac{W_B}{2}$
 (4a)	$M = \frac{W_A a}{2}$	$M = \frac{W_A a}{2} + \frac{W_B L}{8}$	 (4b)	$P = \frac{W_A}{2}$ $Q = \frac{W_A}{2}$	$P = \frac{W_A + W_B}{2}$ $Q = \frac{W_A + W_B}{2}$
 (5a)	W_A only $M_x = \frac{W_A ag}{L} + \frac{W_A bg^2}{2L^2}$ for $x = a + \frac{b\left(\frac{b}{2} + c\right)}{L}$		 (5b)	$P = \frac{W_A}{L}\left(\frac{b}{2} + c\right)$ $Q = \frac{W_A}{L}\left(a + \frac{b}{2}\right)$	$P = \frac{W_A}{L}\left(\frac{b}{2} + c\right) + \frac{W_B}{2}$ $Q = \frac{W_A}{L}\left(a + \frac{b}{2}\right) + \frac{W_B}{2}$

LOAD EQUIVALENTS AND MAXIMUM DEFLECTIONS FOR VARIOUS CONDITIONS OF LOADING.

W_A = Superimposed Load.
W_B = Total Weight of Beam.
L = Effective Span.
I = Moment of Inertia.
E = Modulus of Elasticity.

Condition of Loading.	Safe Load Factor (approx.).	Equivalent Distributed Load including W_B.	Maximum Deflections.	
			Due to Superimposed Load W_A.	Due to Superimposed Load W_A + Weight of Beam W_B.
 (6)	$\frac{1}{4}$	$W_A + W_B$	$\frac{W_A L^3}{8EI}$	$\frac{(W_A + W_B)L^3}{8EI}$
 (7)	$\frac{1}{8}$	$2W_A + W_B$	$\frac{W_A L^3}{3EI}$	$\frac{W_A L^3}{3EI} + \frac{W_B L^3}{8EI}$
 (8)	$1\frac{1}{2}$	$W_A + W_B$	$\frac{W_A L^3}{384EI}$	$\frac{(W_A + W_B)L^3}{384EI}$
 (9)	1	$2W_A + W_B$	$\frac{W_A L^3}{192EI}$	$\frac{W_A L^3}{192EI} + \frac{W_B L^3}{384EI}$
 (10)		For Symmetrical Sections, Working Stress at 7·5 tons per square inch. E = 12,000 tons per square inch. L in feet. δ = Maximum deflection in inches. K = Coefficient, Part I. Then for case (6) $\delta = KL^2 \times 2{\cdot}4$, and for case (7) $\delta = KL^2 \times 3{\cdot}125$. Safe Load Factor (approximate). W = Total Load in Tons. W_T = Tabular Load in Tons, Part I. Then W = W_T × Safe Load Factor.		

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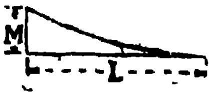
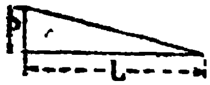
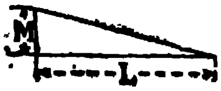
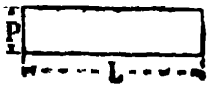
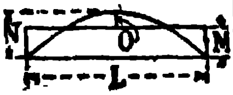
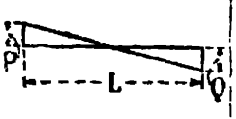
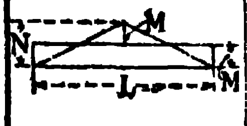
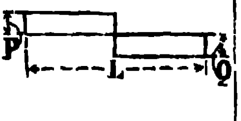
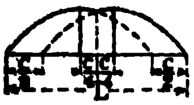
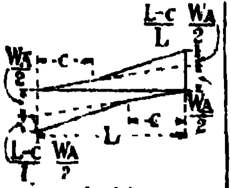
BENDING MOMENTS, REACTIONS, AND VERTICAL SHEARS FOR VARIOUS CONDITIONS OF LOADING.

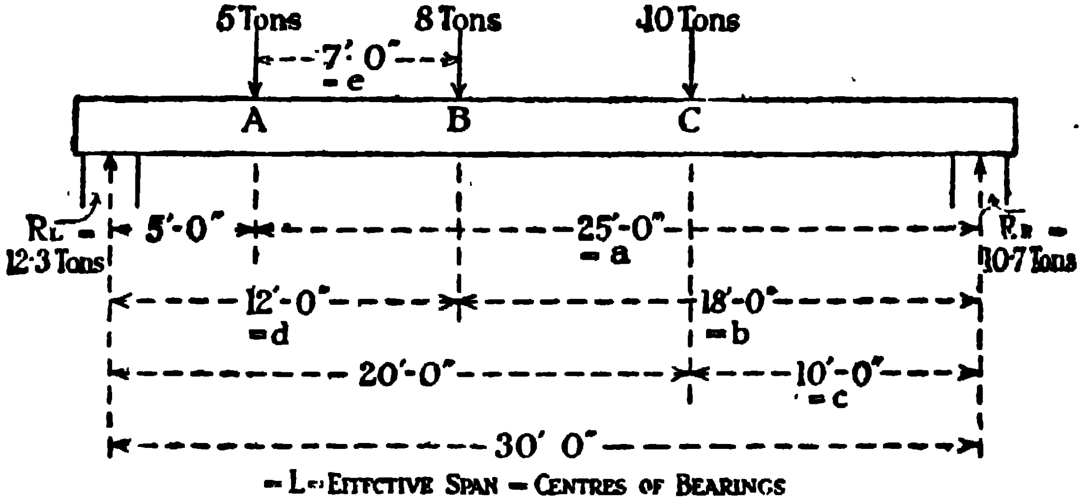
M = Maximum Bending Moment. L = Effective Span.
P = Maximum Positive Shear = Left Hand Reaction.
Q = Maximum Negative Shear = Right Hand Reaction.

Bending Moments.			Reactions and Vertical Shears.		
Diagram.	Maximum due to		Diagram.	Maximum due to	
	W_A only.	$W_A + W_B$.		W_A only.	$W_A + W_B$
 (6a)	$M = \frac{W_A L}{2}$	$M = \frac{(W_A + W_B)L}{2}$	 (6b)	$P = W_A$	$P = W_A + W_B$
 (7a)	$M = W_A L$	$M = \frac{(2W_A + W_B)L}{2}$	 (7b)	$P = W_A$	$P = W_A + W_B$
 (8a)	$M = \frac{W_A L}{12}$ $N = \frac{W_A L}{8}$ $O = \frac{W_A L}{24}$	$M = \frac{(W_A + W_B)L}{12}$ $N = \frac{(W_A + W_B)L}{8}$ $O = \frac{(W_A + W_B)L}{24}$	 (8b)	$P = \frac{W_A}{2}$ $Q = \frac{W_A}{2}$	$P = \frac{W_A}{2} + \frac{W_B}{2}$ $Q = \frac{W_A}{2} + \frac{W_B}{2}$
 (9a)	$M = \frac{W_A L}{8}$ $N = \frac{W_A L}{4}$	$M = \frac{W_A L}{4} + \frac{W_B L}{8}$ $N = \frac{W_A L}{8} + \frac{W_B L}{12}$	 (9b)	$P = \frac{W_A}{2}$ $Q = \frac{W_A}{2}$	$P = \frac{W_A}{2} + \frac{W_B}{2}$ $Q = \frac{W_A}{2} + \frac{W_B}{2}$
 (10a)	$M = \frac{W_A}{4}\left(L - c + \frac{c^2}{4L}\right)$		 (10b)	$P = W_A\left(1 - \frac{c}{2L}\right)$ $Q = W_A\left(1 - \frac{c}{2L}\right)$	

REACTIONS, BENDING MOMENTS, Etc.

The following example shows the method of calculating the reactions, vertical shears, maximum bending moment, and deflection, due to a non-uniform system of loading on a simply supported beam.

The selection of a suitable section from the tables of Part I. is indicated also.



Total load $= W = A+B+C = 5+8+10 = 23$ tons

Left hand reaction $= R_L = \dfrac{(A \times a)+(B \times b)+(C \times c).}{L}$

$$= \frac{5 \times 25 + 8 \times 18 + 10 \times 10}{30} = 12·3 \text{ tons.}$$

Right hand reaction $= R_R = W - R_L = 23 - 12·3.$
$= 10·7$ tons

R_L and R_R are also respectively equal to the maximum positive and maximum negative vertical shears.

Position of zero shear and maximum bending moment. M_r = maximum bending moment in ft. tons.

> Add the loads in succession from left hand. Then B added to A exceeds R_L ∴ Zero shear and maximum bending moment occur at B.

Value of maximum bending moment.

$M_r = R_L \times d - A \times e = 12·3 \times 12 - 5 \times 7 = 112·6$ ft. tons.

SELECTION OF A SUITABLE SECTION.

(*a*) Method 1, by moment of resistance.

The moment of resistance in foot tons required is equal to the maximum bending moment = 112·6 ft. tons.

Refer to Part I., page 65.

The girder composed of 1 steel joist 16″ × 6″ and 2 plates 10″ × ¾″ weighing 115½ lbs. per foot has a maximum moment of resistance of 115·4 foot tons, therefore this section is suitable as regards flexure.

Refer to Part I., page 22.

As the safe load is printed in ordinary type and is between the dotted and full zig-zag lines, the section is suitable also as regards rivet pitch, web buckling and deflection for ordinary conditions.

(*b*) Method 2, by modulus of section. Symbol Z.

The modulus of section Z required is equal to the maximum bending moment in foot tons × 1·6 or $Z = M_r \times 1{\cdot}6 = 112{\cdot}6 \times 1{\cdot}6 = 180{\cdot}16$ inches.^{3}

Refer to Part I., page 22.

The section referred to above has a maximum modulus of section of 184·6 inches^3.

(*c*) Method 3, by equivalent distributed tabular load. W_T.

The equivalent distributed tabular load to be referred to is equal to 8 times the maximum bending moment in foot tons divided by the effective span in feet or

$$W_T = \frac{8M_r}{L} = \frac{8 \times 112{\cdot}6}{30} = 30 \text{ tons approx.}$$

Refer to Part I., page 22.

The tabular load for 30 feet span for the section referred to above is 30·8 tons.

If the depth is unrestricted, reference may be made to Part I., page 16.

Section steel joist, B.S.B., 30, 24″ × 7½″, weighing 100 lbs. per foot, has a maximum moment of resistance in foot tons = 138·2, a maximum modulus of section = 221·2 inches^3, and the tabular load for 30 feet span = 36·8 tons. This is the lightest suitable section available.

Moment of Resistance—(*continued*).

By the following formulæ, the equivalent tabular moment of resistance in foot tons corresponding to any specified extreme fibre stress or factor of safety may be ascertained from the known value of the maximum bending moment in foot tons.

M_F = Maximum bending moment in foot tons.
f = Specified extreme fibre stress in tons per square inch.
F = Factor of safety.
R_T = Equivalent tabular moment of resistance in foot tons.
Then

$$R_T = \frac{7{\cdot}5\,M_F}{f} \text{ or } \frac{M_F\,F}{4}$$

MAXIMUM MODULUS OF SECTION.

An alternative and much used method of selecting a section of beam suitable for any system of loading for which the maximum bending moment is known, is offered by the tabulated values of "**maximum modulus of section**" which for convenience of reference are printed in prominent type.

Any beam or girder will be suitable as regards resistance to flexure provided that it has a "maximum modulus of section" not less than the value ascertained by the appropriate formula of the following, in which :—

Z = tabular section modulus required.
M = maximum bending moment in inch tons.
M_F = " " " " foot tons.
f = extreme fibre stress in tons per square inch.
W = actual load in tons uniformly distributed.
L = effective span in feet.

(*a*) For tabular extreme fibre stress of 7·5 tons per square inch, or factor of safety of 4 and any system of loading.

$$Z = 1{\cdot}6\,M_F \quad \text{or} \quad Z = \frac{M}{7{\cdot}5}$$

(*b*) For any specified extreme fibre stress and any system of loading.

$$Z = \frac{12\,M_F}{f} \quad \text{or} \quad Z = \frac{M}{f}$$

(*c*) For the tabular conditions of load, support and stress.

$$Z = \frac{WL}{5} \text{ for any span in feet.}$$
$$= 2W \text{ for ten feet span.}$$
$$= \frac{W}{5} \text{ for one foot span.}$$

(*d*) For the tabular conditions of load and support and any specified extreme fibre stress.

$$Z = \frac{3WL}{2f} \text{ for any span in feet.}$$

DEFLECTION.

NOTATION.

δ = maximum deflection in inches.
W = load in tons.
W_T = tabular load in tons.
E = modulus of elasticity in tons per square inch.
I = moment of inertia in inches^4.
D = overall depth of beam in inches.
F = factor of safety.
f = extreme fibre stress in tons per square inch.
L = span in feet.
l = span in inches.
K = deflection coefficient.

DERIVATION OF DEFLECTION COEFFICIENTS.

For the tabular conditions of load and support, the general formulæ for the maximum deflection in inches which occurs at the centre of the span is—

$$\delta = \frac{5\,Wl^3}{384\,EI}$$

By substituting equivalent values for W and I, expressing the span in feet, assuming E = 12,000 tons per square inch, $f = 7{\cdot}5$ tons per square inch for safe loads, $f = 30$ tons per square inch for breaking loads, the formula becomes—

$$\delta = \frac{3L^2}{160\,D} \text{ for safe load tables,}$$

$$\text{and} \quad \delta = \frac{12\,L^2}{160D} \text{ for breaking load tables.}$$

Each deflection coefficient "K" of the tables is equal to:—

$$\frac{3}{160\,D} \text{ for safe load tables,}$$

$$\text{or} \quad \frac{12}{160\,D} \text{ for breaking load tables.}$$

Therefore the maximum deflection in inches "δ" is equal to:—

$$KL^2 \text{ for safe load tables,}$$

$$\text{or} \quad \frac{KL^2}{F} \text{ for breaking load tables.}$$

DEFLECTION—(*continued*).

USES OF DEFLECTION COEFFICIENTS.

The tabular deflection coefficients may be used to ascertain the maximum deflection in inches for any specified extreme fibre stress in tons per square inch, or for any specified factor of safety; the nature of the load and support conditions remaining unaltered.

SAFE LOAD TABLES.

For specified extreme fibre stress in tons per square inch, $\delta = \dfrac{KL^2 f}{7{\cdot}5}$	or	For specified factor of safety, $\delta = \dfrac{4\,KL^2}{F}$

BREAKING LOAD TABLES.

For specified extreme fibre stress in tons per square inch. $\delta = \dfrac{KL^2 f}{30}$	or	For specified factor of safety. $\delta = \dfrac{KL^2}{F}$

Example (1):—

(*a*) Required deflection of girder 220 A, 17″ × 10″, page 22, Part I., under tabular load of 37·4 tons, the span being 20 feet.

***Answer*:—**

Deflection coefficient K = ·001103.

$$\therefore\ \delta = KL^2 = {\cdot}001103 \times 20^2.$$

$$= 0{\cdot}44 \text{ inch} = \tfrac{1}{2}'' \text{ approximate.}$$

Example (2):—

(*b*) Required deflection of girder 280 B, 25″ × 16″, page 30, Part I., for a specified extreme fibre stress of 5 tons per square inch, the span being 30 feet.

***Answer*:—**

Deflection coefficient K = ·00075.

$$\therefore\ \delta = \frac{KL^2 f}{7{\cdot}5} = \frac{{\cdot}00075 \times 30^2 \times 5}{7{\cdot}5}$$

$$= 0{\cdot}45 \text{ inch} = \tfrac{1}{2}'' \text{ approximate.}$$

Example (3):—

(*c*) Required deflection of angle BSUA25e, 7″ × 3½″ × ½″, page 84, Part I., for a specified factor of safety of 3, the span being 10 feet.

***Answer*:—**

Deflection coefficient K = ·008333.

$$\therefore\ \delta = \frac{KL^2}{F} = \frac{{\cdot}008333 \times 10^2}{3}$$

$$= 0{\cdot}28 \text{ inch} = \tfrac{1}{4}'' \text{ full.}$$

DEFLECTION—(*continued*).

SAFE LOAD TABLES.

SYMMETRICAL SECTIONS.

Ratio of deflection to span for tabular conditions of stress, load, and support.

If the effective span of a beam is equal to 24 times its depth, the maximum deflection is $\frac{1}{320}$th of the span, or approximately $\frac{1}{26}$th of an inch per foot of span. The full zigzag lines of the tables indicate this limit for each section.

If a beam supports plaster work such a deflection as the foregoing may be excessive; for this condition it is preferable to limit the effective span to 20 times the depth of the beam, in which case the maximum deflection is $\frac{1}{384}$th of the span, or approximately $\frac{1}{32}$nd of an inch per foot of span.

A specification may stipulate that the deflection must not exceed a particular ratio of the span such as $\frac{1}{300}$, $\frac{1}{360}$th, &c.

Let $\frac{1}{\gamma}$ = the specified ratio.

Then for the tabular conditions of stress, load and support, the limiting span :—

$$L = \frac{24D \times 320}{\gamma}$$

To obtain the maximum allowable extreme fibre stress in tons per square inch corresponding to a specified ratio of deflection to span, the formula is :—

$$f = \frac{4800D}{\gamma L}$$

To obtain from the tabular load, the maximum allowable load uniformly distributed corresponding to a specified ratio of deflection to span, the formula is :—

$$W = \frac{640D\,W_T}{\gamma L}$$

or having ascertained f by the previous formula :—

$$W = \frac{f\,W_T}{7{\cdot}5}$$

or from the moment of inertia :—

$$W = \frac{6400\,I}{\gamma L^2}$$

DEFLECTION—(*continued*).

As an example of the foregoing, the 1909 Amendment of the London Building Acts may be cited.

Therein it is stipulated that if the effective span of a beam exceeds 24 times its depth, the deflection must not exceed $\frac{1}{400}$th of the span, or $\frac{1}{\gamma} = \frac{1}{400}$.

For this particular condition—

$$f = \frac{12\,D}{L}$$

and

$$W = \frac{8\,DW_T}{5\,L} \quad \text{or} \quad W = \frac{16\,I}{L^2}$$

Example :—

Required the maximum allowable extreme fibre stress in tons per square inch, and the maximum load uniformly distributed for girder 106A, 14½″ × 10″, page 26, Part I., the effective span being 30 feet and the deflection not to exceed $\frac{1}{400}$th of the span.

Answer :—

$$f = \frac{12 \times 14{\cdot}5}{30} = 5{\cdot}8 \text{ tons per square inch.}$$

$$W = \frac{8 \times 14{\cdot}5 \times 29{\cdot}8}{5 \times 30} = 23 \text{ tons.}$$

$$\text{or } W = \frac{16 \times 1294}{30^2} = 23 \text{ tons.}$$

A beam may have been selected from the tables for a specified load and span, but on calculating the deflection by formula $\delta = K \times L^2$ it is found that the result exceeds that allowable for some particular condition.

In such a case, a deeper or a heavier beam must be chosen.

If the depth is not restricted the required coefficient is found by dividing the allowable deflection by the square of the span in feet, or :—

$$K = \frac{\delta}{L^2}$$

If the depth cannot be increased a suitable beam may be selected by referring to a tabular load equal to the increased load obtained so :—

$$W_T = \frac{WKL^2}{\delta}$$

Deflection—(*continued*).

Example of Unrestricted Depth:—

Required a beam to support 40 tons uniformly distributed over a span of 20 feet, the deflection not to exceed ½ inch.

The depth being unrestricted, the required coefficient,

$$K = \frac{\delta}{L^2} = \frac{\cdot 5}{400} = \cdot 00125$$

Therefore any section for which the tabular load for 20 feet span is not *less* than 40 tons and for which the deflection coefficient is not *greater* than ·00125 is of sufficient strength.

See pages 16 and 17, Part I.

B.S.B. 29, 20″ × 7½″ × 89 lbs. will support 41·8 tons. The deflection coefficient is ·000937 and the deflection for 40 tons is 0·36 inch.

Similarly see pages 24 and 25, Part I. Girder 143A, Part I., 15¾″ × 10″ × 108 lbs. will support 40·7 tons. The deflection coefficient is ·00119 and the deflection for 40 tons is 0·47 inch.

Therefore either of the foregoing sections comply with the conditions.

To show that the deflection coefficient must not exceed $\frac{\delta}{L^2}$ or ·00125 for the example, unless the tabular load is considerably in excess of the specified load.

See pages 36 and 37, Part I.
Try girder 100B, 13″ × 14″ × 138 lbs.
Tabular load for 20 feet = 40·1 tons.
Deflection coefficient = ·001442.
Deflection = 0·57 inch.

Example of Restricted Depth:—

Required a beam not more than 16 inches deep to support 17·4 tons uniformly distributed over a span of 26 feet, the deflection not to exceed 0·52 inch.

See pages 16 and 17, Part I.
B.S.B. 27, 16″ × 6″ × 62 lbs. is suitable for depth and load.

$$\text{Deflection} = K\,L^2 = \cdot 001172 \times 26^2.$$
$$= 0\cdot 787 \text{ inch.}$$

As this exceeds the specified deflection, an increased tabular load must be referred to.

$$\text{This increased load} = \frac{17\cdot 4 \times 0\cdot 787}{0\cdot 52}$$
$$= 26\cdot 4 \text{ tons.}$$

DEFLECTION—(*continued*).

See pages 22 and 23, Part I.
Girder 200A, 16″ × 10″ × 95½ lbs. will support 26·7 tons on 26 feet span.
The deflection coefficient is ·001172, and the deflection for 17·4 tons is 0·516 inch.

Therefore this section complies with all the conditions.

To calculate the maximum deflection in inches for an actual load less than the tabular load the formula is:—

$$\delta = \frac{KL^2W}{W_T}$$

In the last example.

$$\delta = \frac{\cdot001172 \times 26^2 \times 17\cdot4}{26\cdot7}$$

$$= 0\cdot516 \text{ inch.}$$

Particular cases of deflection of unsymmetrical sections, and adaptations of the breaking load tables may be investigated on similar lines to the foregoing.
These are not considered of sufficient importance to treat in detail.

For unsymmetrical sections, substitute for D, twice the distance from the neutral axis to the extreme fibre.

For the breaking load tables substitute $f = 30$ for $f = 7\cdot5$.

It may be pointed out that if a deflection coefficient of the breaking load tables is multiplied by the square of a span in feet, *i.e.*, KL^2, the product is a purely imaginary value which must be divided by a factor of safety to produce a deflection within the elastic limit. See notes to Part I.

DEFLECTION IN PRACTICE.

In practice, and particularly in buildings of the domestic order, which includes offices, clubs and the like, it is frequently observed that the calculated deflection is not realized, but this is due to the fact that the calculated load is not realized in the same proportion.

Another point which may be noted is, that ordinarily a proportion of the loading on a beam is applied gradually as the building operations proceed.

For example, a beam which ultimately will support plaster work, is deflected to some extent by the weight of the floor before the plastering is applied, so that the deflection liable to produce cracks in the plaster is limited to that produced by live load only.

DEFLECTION—(*continued*).

For beams supporting brick walls, the permitted ratios of deflection to span should be as under :—

Length of Span in feet.	Permitted Ratio of Deflection to Span.
Less than 10.	Not exceeding 1/360th.
10 to 15.	1/360th to 1/500th.
15 to 20.	Not exceeding 1/500th.

WEB BUCKLING.

The maximum allowable load on an unstiffened beam or girder, the reaction at the point or points of support, and the minimum span for uniformly distributed loading are limited by the capacity of the web or webs to resist failure by buckling.

The maximum loads or minimum spans indicated in the **tables** by **dotted zigzag** lines have been calculated by the following formulæ which make allowance for the tendency of a web to fail as a thin column by buckling.

d = net depth of web in inches.
t = thickness of web in inches.
n = number of webs (if more than one).
A = total web area in square inches.
q = working stress in tons per square inch of web area.
S = total vertical shear in tons.
W = maximum allowable load in tons uniformly distributed.
W_r = tabular load for 1 foot span.
L = minimum span in feet corresponding to W_r

$$A = d \times t \times n.$$

$$q = 5{\cdot}5 - {\cdot}04\frac{d}{t}$$

$$S = q \times A.$$

S is also the maximum allowable value in tons of a single concentrated load or reaction at any point unless the web is stiffened.

$$W = 2S = 2qA.$$

$$L = \frac{W_r}{2S}$$

MINIMUM SPANS AND MAXIMUM LOADS FOR WEB BUCKLING.

STEEL JOISTS.

Reference Mark.	Section.	Weight per foot in lbs.	Net web area in square inches.	Minimum Span in feet.	Maximum Reaction or Concentrated Load in tons. = S.	Maximum Load Uniformly Distributed in tons. = W.
B.S.B. 30	24 × 7½	100	12·78	10·6	52·1	104·3
B.S.B. 29	20 × 7½	89	10·44	9·2	45·3	90·6
B.S.B. 28	18 × 7	75	8·58	8·5	37·4	74·9
B.S.B. 27	16 × 6	62	7·61	6·6	34·1	68·3
B.S.B. 26	15 × 6	59	6·40	7·3	28·6	57·3
B.S.B. 25	15 × 5	42	5·67	6·0	23·9	47·8
B.S.B. 24	14 × 6*a*	57	5·95	7·0	27·1	54·1
B.S.B. 23	14 × 6*b*	46	4·90	7·5	20·9	41·9
B.S.B. 22	12 × 6*a*	54	4·92	6·7	23·2	46·4
B.S.B. 21	12 × 6*b*	44	4·08	7·2	18·3	36·6
B.S.B. 20	12 × 5	32	3·68	5·8	15·8	31·6
B.S.B. 19	10 × 8	70	4·56	7·6	22·8	45·5
B.S.B. 18	10 × 6	42	3·24	7·0	15·2	30·4
B.S.B. 17	10 × 5	30	3·07	5·2	14·0	27·9
B.S.B. 16	9 × 7	58	3·68	6·9	18·5	36·9
B.S.B. 15	9 × 4	21	2·35	4·3	10·5	21·0
B.S.B. 14	8 × 6	35	2·86	5·0	14·0	28·1
B.S.B. 13	8 × 5	28	2·27	5·2	10·8	21·6
B.S.B. 12	8 × 4	18	1·92	4·0	8·7	17·4
B.S.B. 11	7 × 4	16	1·48	4·2	6·7	13·5
B.S.B. 10	6 × 5	25	1·88	3·8	9·5	19·0
B.S.B. 9	6 × 4½	20	1·77	3·3	8·8	17·7
B.S.B. 8	6 × 3	12	1·31	2·7	6·2	12·4
B.S.B. 7	5 × 4½	18	1·09	4·2	5·4	10·9
B.S.B. 6	5 × 3	11	·89	3·2	4·2	8·5
B.S.B. 5	4¾ × 1¾	6½	·72	2·1	3·3	6·6
B.S.B. 4	4 × 3	9½	·68	2·8	3·3	6·7
B.S.B. 3	4 × 1¾	5	·58	1·7	2·7	5·4
B.S.B. 2	3 × 3	8½	·42	3·0	2·1	4·3
B.S.B. 1	3 × 1½	4	·38	1·5	1·9	3·8

MINIMUM SPANS AND MAXIMUM LOADS FOR WEB BUCKLING.

STEEL CHANNELS.

Reference Mark.	Section.	Weight per foot in lbs.	Net web area in square inches.	Minimum Span in feet.	Maximum Reaction or Concentrated Load in tons.	Maximum Load Uniformly Distributed in tons.
B.S.C. 27	15 × 4	41·94	7·13	3·9	31·8	63·7
B.S.C. 26	12 × 4	36·47	5·56	3·5	26·1	52·2
B.S.C. 25	12 × 3½	32·88	5·33	3·2	24·8	49·5
B.S.C. 24	12 × 3½	26·10	4·07	3·7	17·7	35·3
B.S.C. 23	11 × 4	33·22	4·82	3·4	22·8	45·6
B.S.C. 22	11 × 3½	29·82	4·61	3·1	21·6	43·2
B.S.C. 21	10 × 4	30·16	4·13	3·3	19·7	39·4
B.S.C. 20	10 × 3½	28·21	4·13	3·0	19·7	39·4
B.S.C. 19	10 × 3½	23·55	3·32	3·4	15·1	30·3
B.S.C. 18	9 × 4	28·55	3·66	3·2	17·7	35·5
B.S.C. 17	9 × 3½	25·39	3·49	2·9	16·8	33·6
B.S.C. 16	9 × 3½	22·27	2·95	3·2	13·7	27·5
B.S.C. 15	9 × 3	19·37	3·00	2·6	14·0	27·9
B.S.C. 14	8 × 4	25·73	3·04	3·1	14·9	29·8
B.S.C. 13	8 × 3½	22·72	2·89	2·8	14·0	28·1
B.S.C. 12	8 × 3	19·30	2·58	2·7	12·3	24·6
B.S.C. 11	8 × 2½	15·12	2·19	2·5	10·1	20·2
B.S.C. 10	7 × 3½	20·23	2·34	2·8	11·5	23·0
B.S.C. 9	7 × 3	17·56	2·23	2·5	10·8	21·7
B.S.C. 8	6 × 3½	17·90	1·84	2·7	9·1	18·3
B.S.C. 7	6 × 3	16·29	1·85	2·4	9·2	18·4
B.S.C. 6	6 × 3	14·49	1·56	2·6	7·6	15·2
B.S.C. 5	6 × 2½	12·04	1·61	2·0	7·8	15·6
B.S.C. 4	5 × 2½	10·98	1·30	1·9	6·4	12·9
B.S.C. 3	4 × 2	7·96	0·79	1·8	4·0	7·9
B.S.C. 2	3½ × 2	6·75	0·70	1·5	3·5	7·1
B.S.C. 1	3 × 1½	5·27	0·58	1·1	3·0	5·9

Web Buckling—(*continued*).

Example (1):—

Page 32, Part I., Girder 220 B, 17" × 14" × 174 lbs., composed of 2 steel joists 16" × 6" × 62 lbs. and 2 steel plates 14" × ½".

(*a*) Required the maximum allowable value in tons of a single concentrated load.

From Table, page 272, the value of S for 1 – 16" × 6" joist is 34·1 tons ∴ S for girder = 34·1 × 2 = 68·2 tons.

Example (2):—

(*b*) Required the minimum span for a uniformly distributed load.

Safe load on 1 foot span:—

$$W_r = 1258 \text{ tons.}$$

$$\therefore L = \frac{W_r}{2S} = \frac{1258}{2 \times 68{\cdot}2} = 9{\cdot}2 \text{ feet.}$$

It may also be noted that 9·2 feet is the maximum span for the load of 68 2 tons if concentrated at the centre.

STIFFENERS.

Stiffeners are necessary where the shearing stress is greater than the allowable value of q by the formula on page 271.

Compound Girders.

Stiffeners are rarely required for compound girders except under heavy concentrated loads and over the supports of girders of very short spans.

Plate Girders.

In plate girder work stiffeners are usually provided under all concentrated loads and over all points of support.

General.

Where uniformly distributed loading produces excessive shear, the stiffeners should be placed at distances apart not exceeding the depth of the girder or at a maximum of 5 feet.

Plate Girders.

Where the shearing stress is less than the allowable stress by formula, stiffeners are commonly provided in plate girders. These may be spaced at convenient distances.

Spacing.

In all cases stiffeners should be spaced so as to interfere as little as possible with the uniform pitch of the flange riveting.

For this reason angle sections are more satisfactory than tee sections, although the latter may be used with advantage at a web splice, as they permit of riveting on each side of the joint.

STIFFENERS—(*continued*).

DESIGN OF STIFFENERS.

There is no rational method of determining the sections of stiffeners, practice and experience being the only useful guides.

Some authorities suggest that stiffeners may be considered as round-ended struts, free to move in a direction parallel to the web, the allowable stress per square inch being determined by a suitable stanchion formula.

Such a method may answer for stiffeners over reactions or under concentrated loads of considerable amount, but is unlikely to do so for moderate or uniformly distributed loading, owing to the smallness of the resulting sections.

The minimum size of angle used should not be less than 2″ × 2″ × ¼″, and in general, the sizes of stiffeners should bear a reasonable proportion to the girders they are employed on.

PARALLEL JOISTS AND SEPARATORS.

An economical arrangement for supporting a wall is formed of two or more steel joists parallel and closely adjacent to each other.

In order to insure unity of action, such joists wherever used to support a single load, should be rigidly connected together by separators and bolts.

The separators should be spaced apart throughout the entire length of the joists at distances not exceeding five times the depth over flanges.

They should also be placed immediately over each support and immediately under each concentrated load.

Particulars of cast-iron separators are given on page 317.

RIVET PITCH.

The maximum allowable load on a girder and consequently the minimum span are limited by the capacity of the rivets provided in the flanges to resist the horizontal shear.

In view of the heavy plate thicknesses of the compound girders in Part I., this matter has received most careful consideration, and all tabulated safe loads conditional on a rivet pitch closer than 6 inches are printed in italics.

The inclusion of certain sections for which all the safe loads are printed in italics is intentional.

By this means attention is directed automatically to the limits of flange plating as regards the usual rivet pitch, a matter which, as a rule, does not receive sufficient consideration.

RIVET PITCH—(*continued*).

TABLES OF MINIMUM SPANS.

The tables of minimum spans in feet for various rivet pitches, pages 50 to 59, Part I., have been calculated for the exact distribution of horizontal shear at the meeting surfaces of the plating and the flange of the component joist, joists or channels as the case may be. The maximum value of the horizontal shear at the point where, owing to the diminution of the bending moment value, the plates might be stopped, has been taken in each case.

The method of using the tables is explained fully in Part I.

RIVET SPACING.

The minimum distance from the edge of a rivet or bolt hole to the edge of a member should not be less than the diameter of the hole.

The minimum distance of rivets apart, measured from centre to centre, should not be less than three times the diameter.

The maximum corresponding distance should not exceed sixteen times the thickness of the thinnest member through which they pass.

CURTAILMENT OF FLANGE PLATES.

The plates forming the flanges of heavy compound and plate girders may be stopped before reaching the bearings without affecting the carrying capacity.

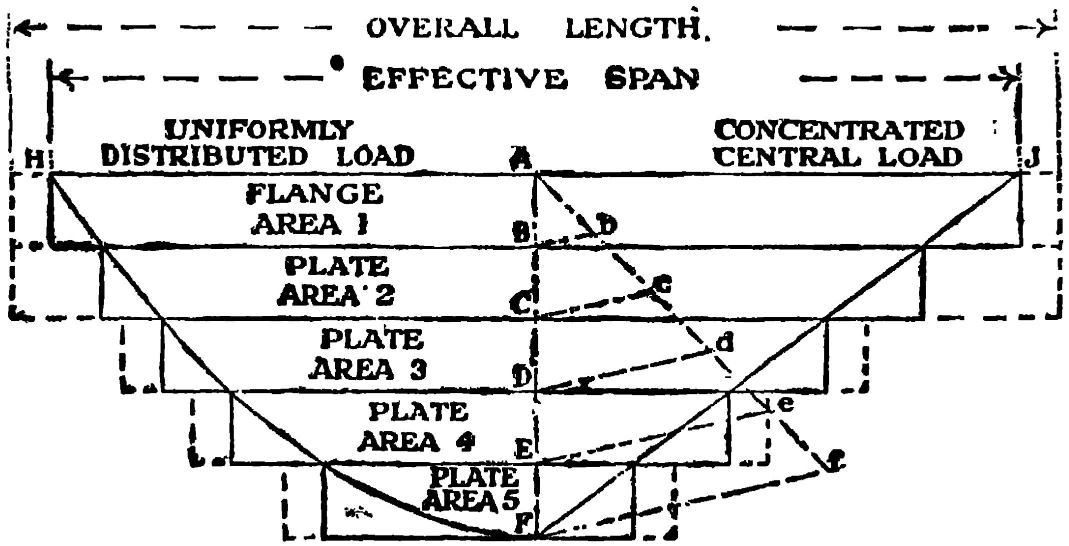
When it is desired to effect economies in this manner, the consequences of producing a flange not of the same level throughout should be considered.

It is obvious for instance, that the top flange plates of a girder for an overhead travelling crane cannot be curtailed with economy, as the rail must be maintained at the same level over its entire length.

The simplest way of ascertaining the points at which the various flange plates may be stopped is the graphic method represented by the following illustration.

The figure shows a bottom flange from the plates, forming which, it is necessary to deduct the loss of area due to rivet holing.

CURTAILMENT OF FLANGE PLATES—(*continued*).



GRAPHIC METHOD.

The left hand of the figure represents the bending moment diagram for a uniformly distributed load, and the right hand figure that for a concentrated central load.

In every case the actual bending moment diagram for the system of loading must be drawn. If the loading is symmetrical about the centre of the span it is only necessary to draw one half of the bending moment diagram.

EXPLANATION :—

From A, draw vertical A—F equal to the maximum bending moment, and construct bending moment diagram A F H, or A F J, or otherwise in accordance with system of loading.

From A draw any convenient line Af, and on it mark lengths, Ab, bc, cd, de, ef representing in succession the net areas of the flange, whether joists, channels or angles, and the various plates 2, 3, 4, and 5.

Join f F, and draw parallels eE, dD, cC, and bB intersecting AF at E, D, C and B.
Draw horizontals through B, C, D, E and F.

Theoretically the plates may be stopped at the intersections of the horizontals with the bending moment diagram, as shown by the heavy solid vertical lines.

In practice, to permit of proper riveting, the plates are made about 9 or 12 inches longer at each end as shown by heavy dotted lines.

Area 2, representing the inner plate, is made the full over-all length of the girder.

BEARING PLATES.

Bearing plates are necessary wherever the area of the portion of the bottom flange of a beam resting on a wall or pier, is such that the unital pressure transmitted exceeds the safe bearing capacity of the supporting material.

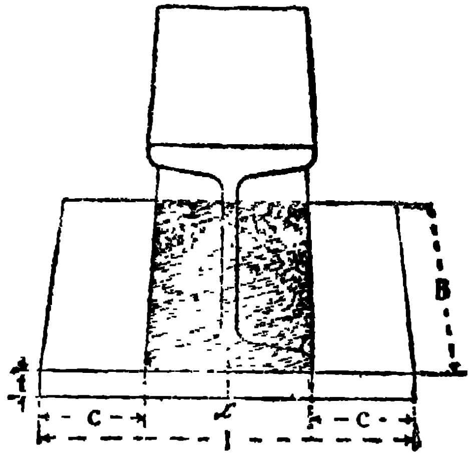
The safe bearing capacity of brick, concrete and other materials are tabulated on page 289.

The superficial area of the bearing plate is determined by dividing the total load transmitted by the safe bearing capacity of the supporting material.

DESIGN OF BEARING PLATES.

In order to ensure proper distribution the bearing plate must be of such a thickness that it will not be liable to bend upwards under the load.

The thickness required may be determined by the undernoted formula.



NOTATION.

f = working stress in tons per square inch.
W = total load on shaded area in tons.
l = length of plate in inches.
B = breadth of plate in inches.
t = thickness of plate in inches.
c = projection of plate beyond beam in inches.

$$t = \sqrt{\frac{1{\cdot}5\,c\,W}{f\,B.}}$$

If f is taken at 9 tons per square inch $t = \sqrt{\frac{cW}{6\,B}}$

This formula is based on the maximum bending moment of the plate which occurs under the centre of the load at x.

Bearing plates should not be made of a thickness less than ½ inch.

APPLICATIONS OF THE TABLES OF PART II.

STANCHIONS. MONCRIEFF FORMULÆ.

Owing to the number of variables on which the calculated strength of a stanchion depends, the tabulated safe concentric loads are not adapted for modifications to the same extent as the tabulated safe loads for beams.

The most convenient general treatment for variations from the tabular end conditions is to ascertain the appropriate working stress per square inch for the required ratio of slenderness and end condition from the table on page 199, Part II.

This value multiplied by the sectional area of the stanchion selected will give the total concentric load.

Example :—

Pages 182-183, Part II. Stanchion No. 9 *f* V; 2 – 3″ × 3″ × ⅜″ angles battened. Least radius of gyration = 1·09 inches.

Area = 6·72 square inches.

Height = 14 feet.

Ratio of slenderness $= \dfrac{14 \times 12}{1 \cdot 09} = 155.$

Required concentric load for "both ends round" and for "both ends fixed."

See page 199, Part II.

(*a*) Both ends round.

For ratio of slenderness $\dfrac{l}{k} = 155$ the working stress, column (1), is 1·56 tons per square inch.

∴ the concentric load is 6·72 × 1·56 = 10·5 tons.

(*b*) Both ends fixed.

The working stress, column (2), is 4·13 tons per square inch.

∴ the concentric load is 6·72 × 4·13 = 27·7 tons.

BOTH ENDS ROUND.

For a stanchion having "both ends round," the corresponding safe concentric load can be got directly from the tables by referring to a height in feet equal to twice the actual height.

This rule is accurate only for ratios of slenderness not exceeding $\dfrac{106 \cdot 9}{2} = 53 \cdot 45.$

Example :—

Pages 132-133, Part II. Stanchion No. 66 K. Steel joist 10″ × 6″ × 146½ lbs. with 2 – 12″ × ⅝″ plates on each flange. Height 10 feet.

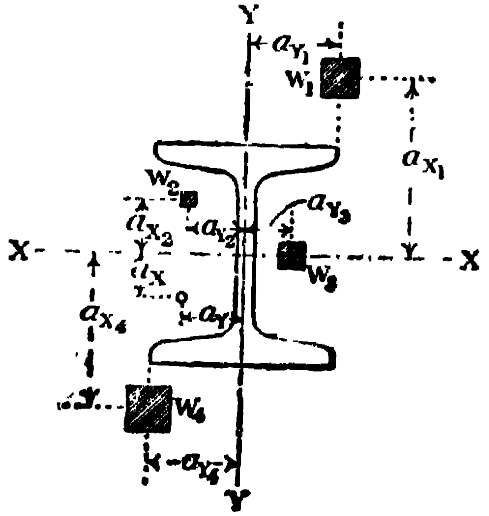
Required concentric load for "both ends round."

Refer to height of 20 feet and read safe load as 251 tons.

As the ratio of slenderness is $\dfrac{10 \times 12}{3} = 40$ ***this result is accurate.***

LOCATION OF THE CENTRE OF APPLICATION OF ECCENTRIC LOAD SYSTEMS.

The "**arm of eccentricity**" or the perpendicular distance from the centre of application of a system of loading to a principal axis of a stanchion is equal to the algebraic sum of the moments of all the loads about the axis, divided by the sum of all the loads.



The moments of the loads on opposite sides of the axis are considered positive and negative respectively, the centre of application of the system being on the same side of the axis as the loads producing the larger sum of moments.

a_X = Arm of eccentricity for axis X—X.
a_Y = „ „ „ Y—Y.

It is required to ascertain the values of a_X and a_Y for the system of loading shown.

For Axis X—X.

$$a_X = \frac{(W_1 \times a_{X_1}) + (W_2 \times a_{X_2}) - (W_4 \times a_{X_4})}{W_1 + W_2 + W_3 + W_4}.$$

It may be noted that as W_3 *is applied on axis* X—X *it has no moment about that axis, but its value as a load is taken in the divisor.*

For axis Y—Y.

$$a_Y = \frac{(W_2 \times a_{Y_2}) + (W_4 \times a_{Y_4}) - (W_1 \times a_{Y_1}) - (W_3 \times a_{Y_3})}{W_2 + W_4 + W_1 + W_3}.$$

For a numerical example let—

$W_1 =$ 8 tons.	$a_{X_1} = 6$ inches.	$a_{Y_1} = 3$ inches.
$W_2 =$ 5 „	$a_{X_2} = 2$ „	$a_{Y_2} = 2$ „
$W_3 =$ 5 „	$a_{X_3} = 0$ „	$a_{Y_3} = 1$ „
$W_4 =$ 10 „	$a_{X_4} = 8$ „	$a_{Y_4} = 3$ „

Then for axis X—X.

$$a_X = \frac{8 \times 6 + 5 \times 2 - 10 \times 8}{8 + 5 + 5 + 10} = \frac{58 - 80.}{28.}$$

$$= 0{\cdot}8 \text{ inch nearly.}$$

a_X is on the same side of axis X—X *as* W_4 *since the moment of* W_4 *is larger than the sum of the moments of* W_1 *and* W_2.

CENTRE OF APPLICATION—(*continued*).

AND FOR AXIS Y—Y.

$$a_Y = \frac{5\times2+10\times3-8\times3-5\times1}{5+10+8+5} = \frac{40-29}{28}.$$

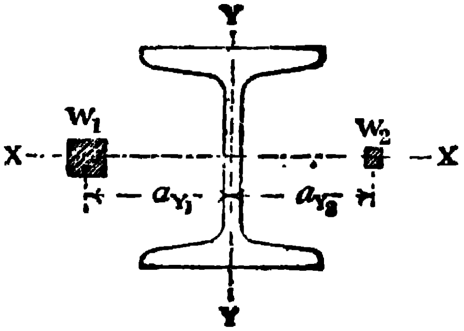
$$= 0{\cdot}4 \text{ inch nearly.}$$

a_Y is on the same side of axis Y—Y as W_2 and W_4.

The foregoing method is applicable to any system of loading.

PARTICULAR CASES.

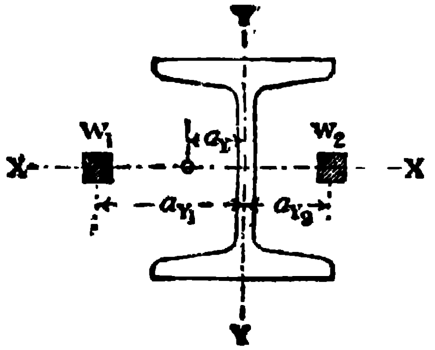
The following alternative methods are applicable to particular cases.



(a) Two loads of unequal values, concentric relative to axis X—X, and equidistant from axis Y—Y, *i.e.* $a_{Y_1} = a_{Y_2}$.

The sum of the loads less their difference, which is equal to twice the value of the lesser load may be treated as concentric, leaving the difference to be treated as eccentric, with an "arm of eccentricity" $a_Y = a_{Y_1}$ or a_{Y_2}.

Then if W_e = the equivalent concentric load value.
and K = the eccentricity coefficient.
$W_e = 2W_2 + K(W_1 - W_2)$.



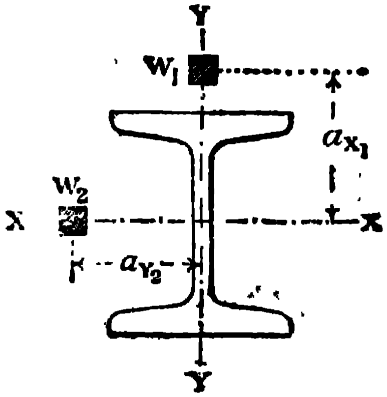
(b) Two loads of equal values, concentric relative to axis X—X but not equidistant from axis Y—Y.

Then, for $W_1 = W_2$

$$a_Y = \frac{a_{Y_1} - a_{Y_2}}{2}$$

In both of these cases the treatment for axis X—X is similar.

Centre of Application—(*continued*).

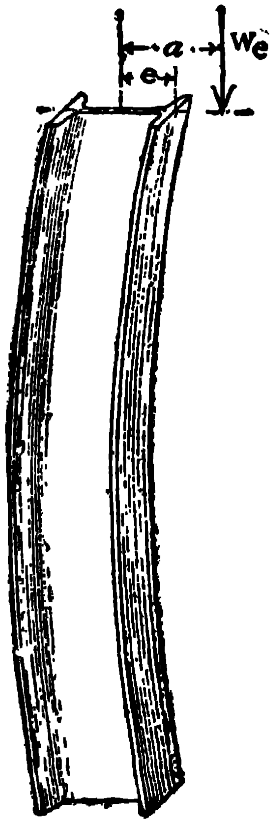


(c) Two loads of equal or unequal values, each concentric relative to one axis, and eccentric relative to the other axis.

Then for axis X—X.
Consider $a_X = a_{X_1}$
and
$W_e = W_2 + (W_1 \times K)$.
And for axis Y—Y.
Consider $a_Y = a_{Y_2}$
and
$W_e = W_1 + (W_2 \times K)$.

The methods of using the tabular eccentricity coefficients are explained in the notes to Part II.

GENERAL FORMULA FOR ECCENTRIC LOADING.



If a stanchion supports an eccentric load We, having an "arm of eccentricity" a about a central axis, load W_e tends to produce bending as shown, tensile stress being developed at the convex side and compressive stress at the concave side.

The maximum compressive stress, which ordinarily is the criterion of strength, occurs at the extreme fibres of the concave side and consists of the direct compressive stress due to the load *plus* the extreme fibre compressive stress due to bending.

Notation.

W_e = actual eccentric load in tons.
A = area of stanchion in square inches.
I = moment of inertia in inches^4 about axis perpendicular to a.
k = radius of gyration in inches = $\sqrt{\frac{I}{A}}$.
M = bending moment in inch tons.
a = arm of eccentricity in inches.
e = perpendicular distance from axis to outer edge of stanchion nearest to load.

General Formula—(*continued*).

f_e = extreme fibre compressive stress in tons per square inch due to bending.

f_c = average stress in tons per square inch due to direct compression.

f = maximum extreme fibre compressive stress in tons per square inch $= f_e + f_c$.

$$M = \begin{cases} W_e \times a \\ \dfrac{f_e \times I}{e} = \dfrac{f_e \times Ak^2}{e} \end{cases}$$

$$\therefore f_e \frac{\times Ak^2}{e} = W_e \times a$$

$$\therefore f_e = \frac{W_e \times a \times e}{Ak^2}$$

$$\text{and } f_c = \frac{W_e}{A}$$

$$\therefore f = f_c + f_e = \frac{W_e}{A} + \frac{W_e \times a \times e}{Ak^2}$$

$$= \frac{W_e}{A}\left(1 + \frac{a\,e}{k^2}\right)$$

W_c = equivalent concentric load value in tons. Then

$$W_c = f \times A = W_e\left(1 + \frac{a\,e}{k^2}\right)$$

Each tabular eccentricity coefficient is equal to $1 + \frac{ae}{k^2}$, the value of $\frac{e}{k^2}$ being the numerical factor of each axial coefficient.

K = eccentricity coefficient.

Then

$$W_c = W_e \times K.$$

BRACKETS ON STANCHIONS.

From the foregoing it is obvious that for each increase of the value of a, the "arm of eccentricity," the value of the load which may be supported safely is correspondingly reduced.

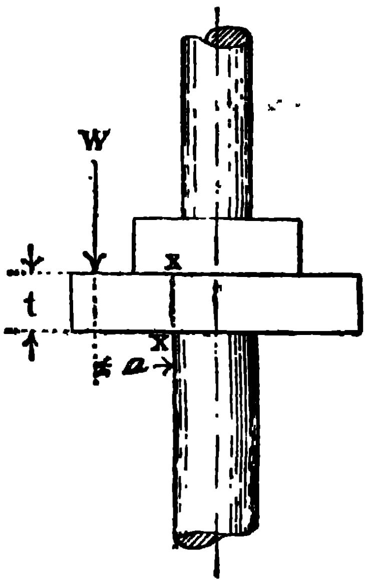
For this reason the projection of a bracket should not be more than the minimum necessary to ensure a proper bearing with sufficient space for connecting bolts.

See types of brackets, Part V.

SLAB CAPS FOR ECCENTRICALLY LOADED SOLID ROUND STEEL STANCHIONS.

The strength of slab caps for eccentrically loaded solid round steel stanchions may be investigated on the following lines:—

The assumption is made that the maximum bending moment will occur at line x—x, the projection of the cap being considered as a cantilever.



NOTATION.

W = eccentric load in tons.
a = distance from centre of application of load to face of stanchion in inches.
B = breadth of cap-plate in inches.
t = thickness of cap-plate in inches.
M = maximum bending moment in inch tons = Wa.
f = working stress of 7·5 tons per square inch.

Then

$$M = Wa = \frac{fBt^2}{6}.$$

Hence

$$t = \sqrt{\frac{6Wa}{fB}} = \sqrt{\frac{Wa}{1\cdot25B}}$$

As a rule the thickness of a slab cap is approximately equal to half the diameter of the stanchion.

LATTICED STANCHIONS.

Various formulæ have been evolved for the determination of the stresses in the lattice bars of stanchions, but none of these can be said to be wholly satisfactory for all conditions of height and loading, and lattice bars are generally designed in accordance with the conventions based on sound practical experience.

The following formulæ are from recent publications.

From "Theory of Structures" by Prof. Spofford.

The theory of this author is as follows:—

The total stress on a lattice bar is the sum of:—
- (*a*) The compressive stress due to bending occasioned by accidental eccentricity.
- (*b*) The compressive stress due to the shortening of the bar occasioned by the direct compression of the stanchion.

LATTICED STANCHIONS—(*continued*).

The formula for the stress due to bending is based on the assumption that the bending moment in the stanchion may be considered equal to that which would occur if the stanchion were loaded uniformly at right angles to its axis throughout its length.

The value of the assumed load is that which would produce a maximum extreme fibre stress equal to the difference between the allowable compressive stress for $\frac{l}{k} = 0$, and the allowable compressive stress for the actual value of $\frac{l}{k}$

This theory is developed to correspond to the bending moment obtained by the straight line formula :—

$$f = 16{,}000 - \frac{70\,l}{k}$$

= the allowable compressive stress in lbs. per square inch.

NOTATION.

f_m = the allowable compressive stress in lbs. per square inch for $\frac{l}{k} = 0$.
f_m = 16,000 lbs. per square inch.
f_b = the extreme fibre stress in lbs. per square inch.
$= f_m - f = 16{,}000 - f.$
$= \frac{70\,l}{k}$
M_P = the maximum bending moment in inch lbs.
W = the total load in lbs. uniformly distributed.
A = area of stanchion in square inches.
I = relative moment of inertia.
l = height of stanchion in inches.
e = distance from neutral axis to extreme fibres in inches.
k = relative radius of gyration.
S = total shear in lbs.

Hence :—

$$M_P = \frac{f_b \times I}{e} = \frac{W\,l}{8}$$

$$f b = \frac{M_P \times e}{I} = \frac{W \times l \times e}{8\,I} = \frac{W \times l \times e}{8 \times A \times k^2}$$

$$\therefore \frac{W \times l \times e}{8 \times A \times k^2} = \frac{70\,l}{k}$$

LATTICED STANCHIONS—*(continued)*.

Hence—

$$W = \frac{70\,l}{k} \times \frac{8 \times A \times k^2}{l \times e}$$

$$= \frac{560\,A\,k}{e}$$

$$\text{But } S = \frac{W}{2}$$

$$\therefore S = \frac{280\,A\,k}{e}$$

or

$$S \text{ in tons} = \frac{A\,k}{8\,e}$$

P = the total compressive stress in one lattice bar in tons.

θ = the angle of inclination of lattice to the horizontal, not greater than 45°.

$$P = \frac{A\,k}{16\,e} \sec \theta.$$

This method gives the stress in the end lattice bars, but it is common to use the same size of bars throughout the length of the stanchion.

The compressive stress due to the shortening of the bar is calculated by the general formulæ of the theory that within the elastic limit unital stress is proportional to unital deformation.

p = the unital compressive stress in one lattice bar occasioned by the direct compression of the stanchion.

$p = f \sin^2 \theta.$

a = the area of one lattice bar.

Therefore the total unital compressive stress in one lattice bar due to bending and direct compression.

$$= \frac{Ak \sec \theta}{16\,e\,a} + f \sin^2 \theta.$$

$$= \frac{P}{a} + p.$$

The value so ascertained must not exceed the allowable compressive stress by stanchion formula for the actual value of $\frac{l}{k}$ *for the bar.*

LATTICED STANCHIONS—(*continued*).

The following is adapted from a widely used American specification:—

See Proc. Am. Soc. C.E., Vol. 37, Feb. 1911. Discussion on Mr. Howard's paper on "Tests of Large Steel Columns."

NOTATION.

S = transverse shear in tons.
A = area of stanchion in square inches.
k = relative radius of gyration in inches.
e = distance from neutral axis to extreme fibres in inches.
P = the total compressive stress in one lattice bar in tons.
θ = the angle of inclination of lattice to the horizontal not greater than 45°.

$$S = \frac{A\,k}{7e}$$

$$P = \frac{A\,k}{14e} \sec \theta.$$

It will be observed that the above value of P is similar to that of Prof. Spofford's, except for the value of the constant in the denominator.

From "Steel Structures," by Clyde T. Morris.

The theory of this author is as follows:—

In a loaded stanchion having both ends fixed, points of contra-flexure are developed.

At these points of contra-flexure the bending moment is zero, and consequently the stress on the cross section is uniform.

Midway between these points the bending moment and the compressive stress at the extreme fibres on the concave side are maximum.

Therefore in a distance equal to ¼th of the total length of a fixed ended stanchion, the unital stress in the concave side must change from the average to the maximum allowed.

Whence Mr. Morris deduces a formula for the longitudinal increment of stress in one leaf per unit of length of stanchion, and he states that sufficient connection must be provided between the two leaves of the stanchion to transmit this stress.

A = the area of the stanchion in square inches.
f_m = the allowable compressive stress per square inch by stanchion formula when $\frac{l}{k} = 0$.
f = the allowable compressive stress per square inch by stanchion formula for actual value of $\frac{l}{k}$

LATTICED STANCHIONS—(*continued*).

L = total length of stanchion in feet.

p = change in the total stress in one leaf per unit of length.

$$p = \frac{2A\,(f_m - f)}{L.}$$

From the foregoing an expression for the total compressive stress in one lattice bar may be derived.

c = the horizontal centres of rivets in inches.

θ = the angle of inclination of lattice to the horizontal, not greater than 45°.

P = the total compressive stress in one lattice bar.

$$P = \frac{A \times c \sec \theta\,(f_m - f)}{L \times 12}$$

FOUNDATIONS FOR STANCHIONS.

For the purpose of calculating the total load on stanchion foundations in buildings of more than two storeys in height, excepting buildings of the warehouse class, certain deductions from the live or superimposed loads are permitted, but in every case the dead load must be allowed for in full.

Position of Superimposed Load in Building.	Percentage of each superimposed load to be allowed for on stanchion foundations.
On Roof, - - - - - - - - - -	100 per cent.
" Top Floor, - - - - - - - - -	100 "
" Next Floor below, - - - - - -	95 "
" " " " - - - - - -	90 "
" " " " - - - - - -	85 "
" " " " - - - - - -	80 "
and so on, the percentage being decreased by 5 per cent. at each succeeding lower floor until at the 11th floor below the roof the allowable minimum is reached, viz., -	50 "

In all important work the bearing value of the soil should be ascertained by experiment.

On the following page is a table of generally accepted values for the soils, &c., particularized.

SAFE PRESSURES ON FOUNDATIONS AND MASONRY.

AVERAGE VALUES.

FOUNDATIONS.

	Tons per square foot.
Chalk, Hard,	6
Clay, Ordinary,	2
" Hard Compact,	4—5
Earth, Ordinary Firm,	1
Gravel, Ordinary,	3
" Compact,	4—8
Rock,	16

MASONRY.

Brick, Ordinary in Cement Mortar,	5
" Hard (including London Stocks) in Cement Mortar,	8
" Blue in Cement Mortar,	12
Concrete Lime (good),	8
" Cement (1—2—4),	12
Freestone, Square Rubble Masonry in Cement,	8
" Ashlar Masonry in Cement,	15
" Ashlar Bearing Blocks,	12
Granite Ashlar Masonry in Cement,	25
" Ashlar Bearing Blocks,	20
Granolithic Bearing Blocks,	12

STEEL GRILLAGE FOUNDATIONS.

Owing to the low bearing capacity of certain soils it is often essential to distribute a load over a large area.

This is accomplished efficiently and economically by a properly proportioned beam grillage.

The thinness of the foundation so obtainable saves the cost of the deep excavations and large masses of solid concrete otherwise necessary.

A particular advantage of a beam grillage is that by obviating penetration, it may be possible to support a load entirely on a hard crust overlying strata of a soft nature.

A beam grillage consists of one, two or more tiers of steel joists superimposed on a layer of concrete.

Concrete is also rammed into the spaces between the webs of the joists, the flanges being kept sufficiently far apart to allow of this being done properly.

Steel Grillages—(*continued*).

To avoid displacement during the ramming of the concrete, long bolts with tube separators should pass through the webs of each tier. The flanges of the tiers should also be bolted together.

Joists forming alternate tiers are placed at right angles to each other.

If a grillage consists of two tiers only :—

(*a*) the breadth of the upper tier and one side of the stanchion base are equal.

(*b*) the length of the upper tier and breadth of the lower tier are equal.

If a grillage consists of more than two tiers :—

(*a*) the breadth of an intermediate tier and the length of the next tier above are equal.

(*b*) the length of an intermediate tier is a convenient proportion of the length or breadth of the bottom tier.

Ordinarily the length and breadth of the bottom tier are approximately equal.

Design of Beam Grillages.

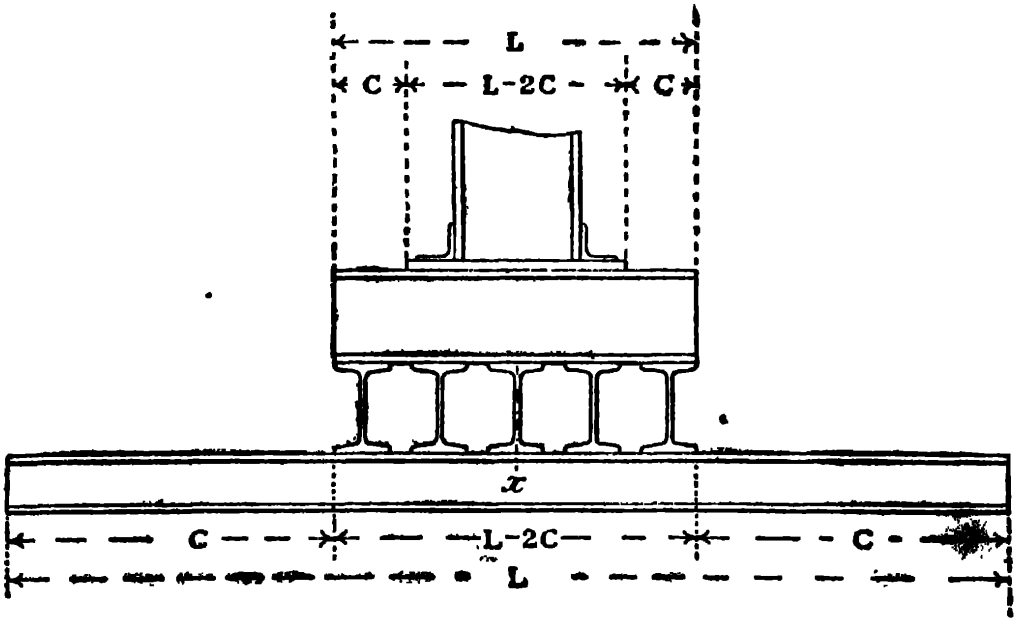
To design a beam grillage it is necessary to know :—

(*a*) the total load on the stanchion in tons.

(*b*) the size of the stanchion base.

(*c*) the safe bearing capacity of the soil in tons per square foot, for which see page 289 *ante*.

The superficial area and consequent overall length and breadth of the bottom tier are determined by dividing the total load by the safe bearing capacity of the soil.



STEEL GRILLAGES—(*continued*).

The diagram represents a three tier grillage.

NOTATION.

P = total load in tons on the stanchion.
n = number of joists in the tier.
W = load in tons on one joist of the tier.
= P ÷ n.
L = length of the joist in feet.
C = projection in feet.

A suitable section of joist may be selected from the tables in Part I., pages 16 to 19, by either of the two following methods :—

A joist is suitable if,

(*a*) the tabular load is not less than W for a span equal to 2C feet.

(*b*) the maximum modulus of section is not less than $\frac{C \times W}{2 \cdot 5}$

To prevent web buckling, the load W should not exceed the maximum tabular load for the section of joist selected, or the maximum value of W tabulated on page 272, unless stiffeners are provided.

Example :—

Design a beam grillage for a stanchion.

(*a*) the total load = 200 tons.
(*b*) the size of stanchion base = 3 feet square.
(*c*) the safe bearing capacity of the soil = 2 tons per square foot.

Arrange for a three tier grillage.

Area of bottom tier $= \frac{200}{2} = 100$ square feet.

= 10 feet long × 10 feet broad.

TOP TIER.

Breadth, 3 feet. Length, say 6 feet.
In breadth of 3 feet, 4 beams can be placed with sufficient space for ramming concrete.

P = 200. n = 4. $\therefore W = \frac{200}{4} = 50$ tons.

2C = 6 − 3 = 3 feet (the equivalent span).
Refer to tables, Part I. Pages 16 and 17.
As the shortest tabulated span is 10 feet, calculate the maximum modulus of section required.

STEEL GRILLAGES—(*continued*).

$$Z=\frac{CW}{2{\cdot}5}=\frac{1{\cdot}5\times 50}{2{\cdot}5}=30 \text{ inches}^3.$$

The maximum modulus of section of steel joist 10″ × 5″ × 30 lbs. is 29·1 inches³ which is sufficiently near, therefore the section is suitable as regards flexural strength.

For Web buckling refer to page 272. The maximum allowable load is 27·9 tons, therefore 3 sets of cast iron stiffeners instead of the ordinary distance tubes will be required. These may be spaced equally at about 2 feet 9 inches centre to centre.

MIDDLE TIER.

Breadth 6 feet, length 10 feet.

In breadth of 6 feet, 8 beams can be placed.

$$P = 200,\ n = 8\ \therefore\ W = \frac{200}{8} = 25 \text{ tons.}$$

$2C = 10 - 3 = 7$ feet (the equivalent span).

$$Z = \frac{CW}{2{\cdot}5} = \frac{3{\cdot}5\times 25}{2{\cdot}5} = 35 \text{ inches}^3.$$

The maximum modulus of section of steel joist 12″ × 6″ × 32 lbs. is 36·6 inches³, and the maximum allowable load is 31·6 tons, therefore the section is suitable both as regards flexural strength and web buckling.

BOTTOM TIER.

Breadth 10 feet, length 10 feet.

In breadth 10 feet, 14 beams can be placed.

$$P = 200,\ n = 14\ \therefore\ W = \frac{200}{14} = 14{\cdot}3 \text{ tons.}$$

$2C = 10 - 6 = 4$ feet (the equivalent span).

Refer to page 18, Part I.

Steel joist 6″ × 4½″ × 20 lbs. will support 14·4 tons on 4 feet span, therefore this section is suitable.

DERIVATION OF FORMULÆ.

In the foregoing, the assumption is made that the maximum bending moment occurs at the point x the centre of L.

Some authorities prefer to treat length C as a cantilever, with the maximum bending moment occurring at the edge of the tier above.

STEEL GRILLAGES—(*continued*).

Should inequality of bending take place between adjacent tiers or between the top tier and the base plate, the stresses become somewhat indeterminate and under all conditions it is desirable that the worst case likely to occur as represented by maximum bending moment at x, should be provided for.

The rules given for the selection of suitable sections are derived from first principles as follows :—

Consider one beam of the lower tier in diagram.

The load W is assumed to be distributed uniformly over the length L - 2 C, and the total reaction or upward pressure exerted by the soil is also W uniformly distributed over the total length L.

Taking moments about x.

$$\text{M (foot-tons)} = \left(\frac{W}{2} \times \frac{L}{4}\right) - \left\{\frac{W}{2} \times \left(\frac{L - 2C}{4}\right)\right\}$$

$$= \frac{W}{8}\left\{L - (L - 2C)\right\} = \frac{2CW}{8}$$

But $\frac{2CW}{8}$ is equivalent to the maximum bending moment occurring in a beam supporting a uniformly distributed load over a span of 2 C feet, therefore rule No. 1 follows :—

For equilibrium M must equal R.

$$\text{M (inch tons)} = \frac{2CW}{8} \times 12 = 3CW.$$

$$R = fZ \quad \therefore \quad Z = \frac{3CW}{f}$$

and for the tabular conditions for which f is equal to 7·5 tons per square inch.

$$Z = \frac{3CW}{7 \cdot 5} = \frac{CW}{2 \cdot 5}$$

OVERHEAD TRAVELLING CRANES.

WHEEL LOADS.

Full particulars of the maximum load on each of the end carriage wheels, and also the centres of the wheels should be obtained from the firm supplying an overhead travelling crane.

If such particulars are not available, the following table will be found useful as a guide, but the data can only be considered as approximately correct as the weights and wheel centres of cranes of the same lifting capacity vary considerably for different makes.

ELECTRIC OVERHEAD TRAVELLING CRANES.

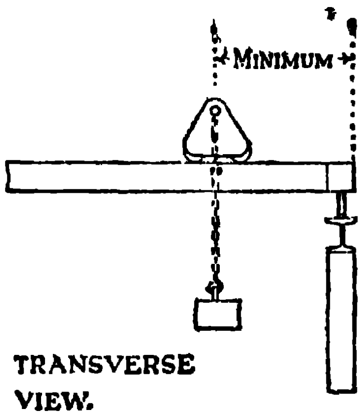
APPROXIMATE PARTICULARS.

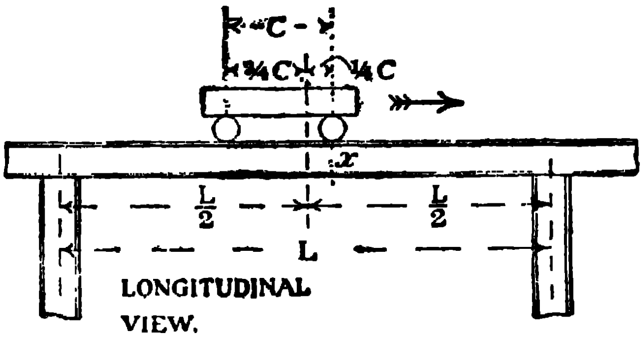
Lift in tons.	DIMENSIONS.				LOADS.				
	Span in feet.	Wheel Base in feet.	Head-room in feet.	End-room in inches.	Total weight of crane in tons *excluding lift.*	Maximum loads *on each end carriage wheel* due to proportion of—			
						Weight in tons.	Lift in tons.	Weight and Lift.	
								Actual total in tons.	Equivalent static in tons.
3	25	7·5	4·75	7·5	7·0	1·75	1·5	3·25	4·75
	35	7·5	"	"	8·25	2·07	"	3·57	5·07
	45	9·0	"	"	10·5	2·63	"	4·13	5·63
5	25	7·5	5·5	8·5	8·5	2·13	2·5	4·63	7·13
	35	7·5	"	"	9·75	2·44	"	4·94	7·44
	45	9·0	"	"	11·5	2·88	"	5·35	7·88
10	30	8·0	6·0	9·0	11·25	2·82	5·0	7·82	12·82
	40	8·0	"	"	13·0	3·25	"	8·25	13·25
	50	10·0	"	"	16·25	4·07	"	9·07	14·07
15	30	8·0	6·5	9·5	14·25	3·57	7·5	11·27	18·57
	40	8·0	"	"	16·5	4·13	"	11·63	19·13
	50	10·0	"	"	20·0	5·0	"	12·5	20·0
20	40	9·0	7·0	10·0	21·25	5·32	10·0	15·32	25·32
	50	10·0	"	"	25·0	6·25	"	16·25	26·25
	60	12·0	"	"	28·5	7·13	"	17·13	27·13
25	40	9·0	7·5	10·5	23·5	5·88	12·5	18·38	30·88
	50	10·0	"	"	27·5	6·88	"	19·38	31·88
	60	12·0	"	"	31·5	7·88	"	20·38	32·88

For explanation of equivalent static loads in tons, see page 296.

Overhead Travelling Cranes—(*continued*).

Maximum Load and Bending Moment.





Maximum Load.

The maximum load on a longitudinal crane girder occurs at each wheel of the end carriage next to which the crab is sustaining the full lift, as shown in transverse view above.

Maximum Bending Moment.

The maximum bending moment occurs at x (longitudinal view), when the front wheel has advanced beyond the centre of the span a distance equal to ¼ C (the end carriage wheel centres), unless C is greater than $\frac{L}{2}$ in which case the maximum bending moment occurs at the centre of the span when the front wheel is over it.

For formula for value of maximum bending moment, see page 261.

Dynamic Effect.

The maximum stress produced by a suddenly applied load is **double** that produced by a static load.

Proportion of Static and Dynamic Loading.

In applying this law to the case of an overhead travelling crane under ordinary working and speed conditions, the weight of the crane itself as it moves along a longitudinal crane girder to the position of maximum bending moment, may be considered as gradually applied or static.

The full lift or capacity of the crane, working at this position for maximum effect is taken as suddenly applied or dynamic.

OVERHEAD TRAVELLING CRANES—(*continued*).

This principle may be used to obtain an equivalent static load to which the ordinary static stress is applicable.

EQUIVALENT STATIC LOAD.

NOTATION.

W_c = weight of crane.
W_L = lift or capacity of crane.
W_s = equivalent static load on each wheel of an end carriage.
$W_s = \frac{1}{4}W_c + W_L$.

See table, page 294.

VARIABLE WORKING STRESS.

f = static or ordinary dead load working stress.
f_R = variable working stress regulated by the relative proportions of weight and capacity of crane.

$$f_R = f\left(\frac{W_c + 2\,W_L}{W_c + 4\,W_L}\right)$$

The foregoing does not take account of impact.

IMPACT.

Certain cranes are constructed to lower the burden very rapidly and stop instantaneously, thus producing the effect of impact.

Other analogous cases occur in practice and each of these require to be considered specially.

LATERAL FORCES.

Provision should be made for the resistance of the lateral forces exerted on the top flange of a longitudinal crane girder by the cross travel of the crab and by the dragging of loads across the shop floor.

The intensity of these forces must vary according to circumstances, but as a minimum it is usual to provide for a horizontal force of not less than $\frac{1}{10}$th of the maximum lifting capacity of the crane.

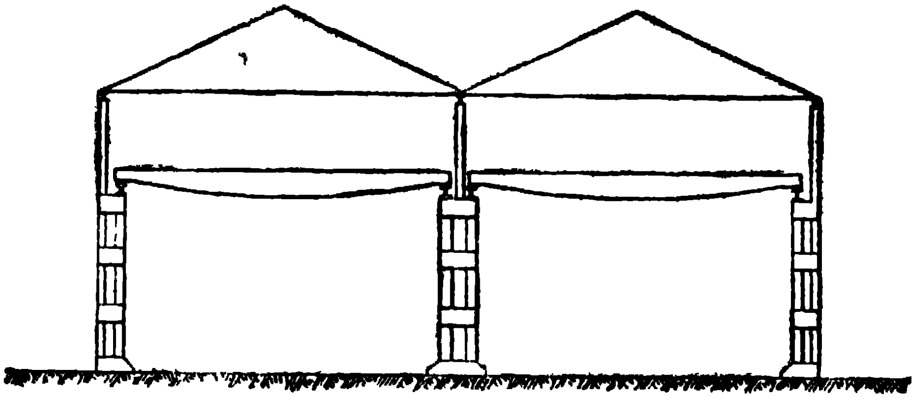
MAXIMUM STANCHION LOAD.

The maximum load on the stanchion occurs when one wheel of the end carriage is immediately over it. The value of the maximum load is equal to the value of the maximum shear for which see page 261.

ECCENTRIC LOADING.

The sketch on the following page represents the cross section of a familiar type of engineering shop with an overhead travelling crane in each bay.

OVERHEAD TRAVELLING CRANES—*(continued)*.



The stanchions are each composed of two or more members, one of which is continued above the level of the longitudinal crane girders to support the roof.

If the stanchions are considered as compound sections:—

(*a*) The system of loading on the side stanchions due to the crane and roof is eccentric about the axis of the stanchion parallel to the longitudinal crane girders, unless the stanchion is symmetrical about that axis and the values of the crane and roof loads are equal. The exception is not likely to occur in practice.

(*b*) On the valley stanchions, considering the same axis, greater stresses may be produced by the eccentricity of one crane acting alone, than by the balanced or partially balanced system of loading due to both cranes acting together.

CONCENTRIC LOADING.

If the roof loads are very small in comparison with the crane loads, it may be more economical to proportion each member of the stanchion separately of sufficient strength for the particular load it has to support, each load being treated as concentric.

DESIGN OF STANCHIONS.

In proportioning stanchions for overhead travelling cranes, the method of obtaining an equivalent static load to which the tabular conditions are applicable will be found convenient.

WIND PRESSURE.

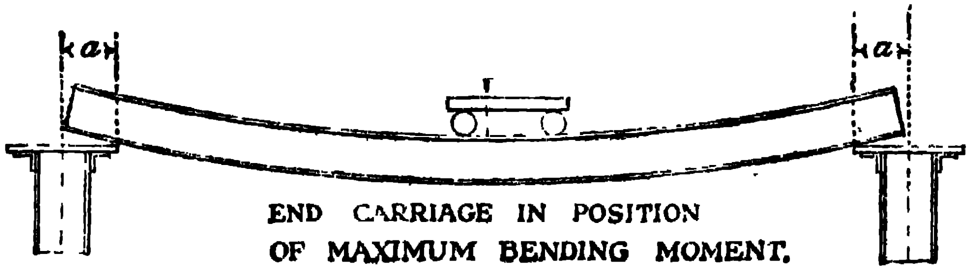
The effect of the wind pressure on the roof and side of the building must be allowed for in all cases.

OVERHEAD TRAVELLING CRANES—*(continued).*

TRANSVERSE AXIS.

It is usual to treat the loading as concentric about the axis of the stanchion parallel to the cross crane girders.

It should be noted, however, that if the longitudinal crane girders are not sufficiently rigid to prevent an appreciable degree of bending, and are not properly connected at the joints, the condition indicated to an exaggerated extent by the sketch may be developed.



END CARRIAGE IN POSITION
OF MAXIMUM BENDING MOMENT.

Under such circumstances the bearing is transferred to the edge of the cap-plate of the stanchion, and the proportion of the total load equal to the reaction will act with an arm of eccentricity of a maximum value equal to half the length of the cap-plate.

MOMENT OF INERTIA.

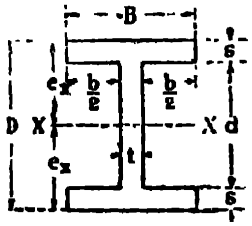
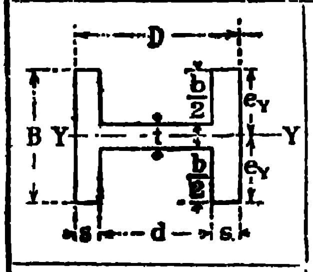
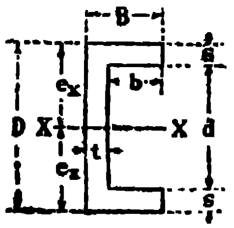
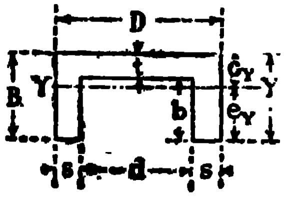
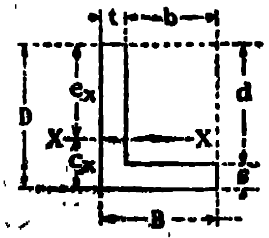
REFERENCE TO FORMULÆ, Pages 299 to 302.

These tabulated formulæ for the moment of inertia of joists, channels, angles, and tees do not take account of the rounded corners, fillets and tapered flanges of sections rolled to the British standard dimensions.

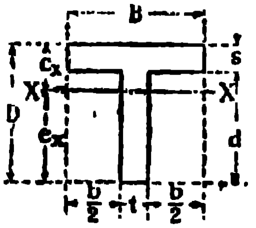
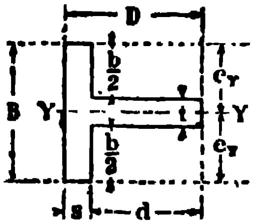
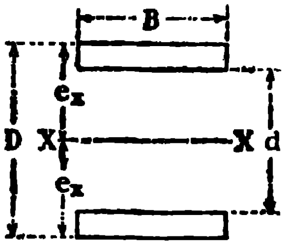
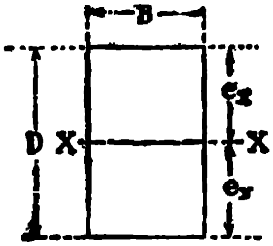
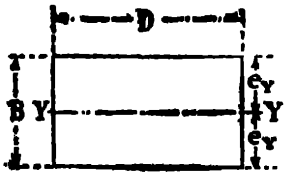
The resulting values, therefore, do not coincide exactly with the strictly accurate properties in Parts I. and II.

The remaining formulæ are for the various outlines, viz. :—rectangles, triangles, positive and negative sectors of circles into which the profiles of the rolled sections may be divided.

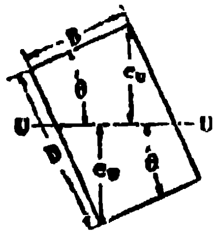
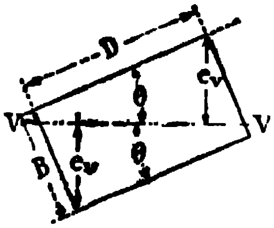
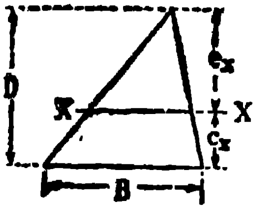
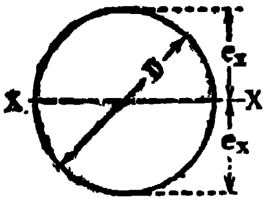
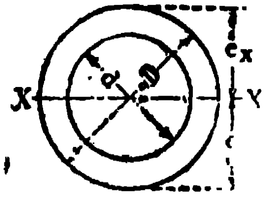
PROPERTIES OF VARIOUS SECTIONS.

Section.	Area = A.	Distance to Extreme Fibres = e.	Moments of Inertia.	
			About Central Axis = I.	About Parallel Axis O—O = I_0.
 B s e_X $\frac{b}{2}$ $\frac{b}{2}$ D X X d e_X t s	2Bs + dt or BD − bd	$\frac{D}{2}$	I_X $\frac{BD^3 - bd^3}{12}$	$I_X + Ae_0^2$ or if $e_0 = e_X$ $\frac{BD^3 + bs^3 - b(d+s)^3}{3}$
 D $\frac{b}{2}$ e_Y B Y t Y $\frac{b}{2}$ e_Y s d s	2Bs + dt or BD − bd	$\frac{B}{2}$	I_Y $\frac{2sB^3 + dt^3}{12}$	$I_Y + Ae_0^2$ or if $e_0 = e_Y$ $\frac{2sB^3 + d\left(\frac{b}{2} + t\right)^3 - d\frac{b^3}{8}}{3}$
	2Bs + dt or BD − bd	$\frac{D}{2}$	I_X $\frac{BD^3 - bd^3}{12}$	$I_X + Ae_0^2$ or if $e_0 = e_X$ $\frac{BD^3 + bs^3 - b(d+s)^3}{3}$
	2Bs + dt or BD − bd	$\frac{DB^2 - db^2}{2A}$	I_Y $\frac{2se_Y^3 + Dc_Y^3 - d(c_Y - t)^3}{3}$	$I_Y + Ae_0^2$ or if $e_0 = e_Y$ $\frac{DB^3 - db^3}{3}$ or if $e_0 = c_Y$ $\frac{2sB^3 + dt^3}{3}$
	Dt + bs or Bs + dt or BD − bd	$\frac{BD^2 - bd^2}{2A}$	I_X $\frac{te_X^3 + Bc_X^3 - b(c_X - s)^3}{3}$	$I_X + Ae_0^2$ or if $e_0 = e_X$ $\frac{BD^3 - bd^3}{3}$ or if $e_0 = c_X$ $\frac{tD^3 + bs^3}{3}$

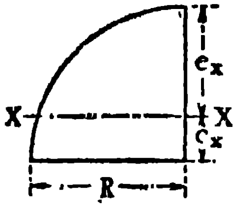
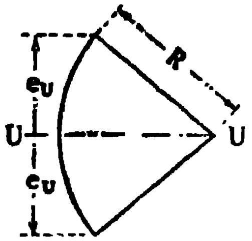
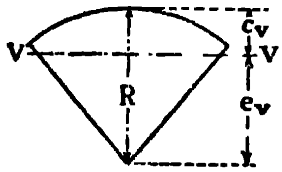
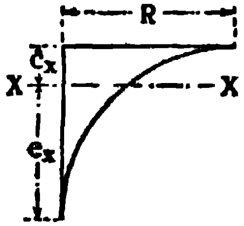
PROPERTIES OF VARIOUS SECTIONS.

Section.	Area = A.	Distance to Extreme Fibres = e.	Moments of Inertia.	
			About Central Axis = I.	About Parallel Axis O–O = I_o.
 B c_X s X X D e_X d $\frac{b}{2}$ t $\frac{b}{2}$	Dt + bs or Bs + dt or BD - bd	$\frac{BD^2 - bd^2}{2A}$	I_X $\frac{te_X^3 + Bc_X^3 - b(c_X - s)^3}{3}$	$I_X + Ae_0^2$ or if $e_0 = e_X$ $\frac{BD^3 - bd^3}{3}$ or if $e_0 = c_X$ $\frac{tD^3 + bs^3}{3}$
 D $\frac{b}{2}$ e_Y B Y t Y $\frac{b}{2}$ e_Y s d	Dt + bs or Bs + dt or BD - bd	$\frac{B}{2}$	I_Y $\frac{sB^3 + dt^3}{12}$	$I_Y + Ae_0^2$ or if $e_0 = e_Y$ $\frac{sB^3 + d\left(\frac{b}{2} + t\right)^3 - d\frac{b^3}{8}}{3}$
	B(D - d)	$\frac{D}{2}$	I_X $\frac{B(D^3 - d^3)}{12}$	$I_X + Ae_0^2$ or if $e_0 = e_X$ $\frac{B(D^3 - d^3)}{12} + \frac{Bd^2t}{2}$
	BD	$\frac{D}{2}$	I_X $\frac{BD^3}{12}$	$I_X + Ae_0^2$ or if $e_0 = e_X$ $\frac{BD^3}{3}$
	DB	$\frac{B}{2}$	I_Y $\frac{DB^3}{12}$	$I_Y + Ae_0^2$ or if $e_0 = e_Y$ $\frac{DB^3}{3}$

PROPERTIES OF VARIOUS SECTIONS.

Section.	Area = A.	Distance to Extreme Fibres = e.	Moments of Inertia.	
			About Central Axis = I.	About Parallel Axis O—O = I_o.
	BD	$\frac{B\sin\theta + D\cos\theta}{2}$	I_v $\frac{BD(B^2\sin^2\theta + D^2\cos^2\theta)}{12}$	$I_v + Ae_o^2$
	DB	$\frac{D\sin\theta + B\cos\theta}{2}$	I_v $\frac{DB(D^2\sin^2\theta + B^2\cos^2\theta)}{12}$	$I_v + Ae_o^2$
	$\frac{BD}{2}$	$\frac{2D}{3}$	I_x $\frac{BD^3}{36}$	$I_x + Ae_o^2$ or if $e_o = e_x$ $\frac{BD^3}{4}$ or if $e_o = c_x$ $\frac{BD^3}{12}$
	$\frac{\pi D^2}{4}$ or $\cdot 7854D^2$	$\frac{D}{2}$	I_x $\frac{\pi D^4}{64}$ or $\cdot 0491D^4$	$I_x + Ae_o^2$ or if $e_o = e_x$ $\frac{5\pi D^4}{64}$ or $\cdot 2455D^4$
	$\frac{\pi(D^2 - d^2)}{4}$ or $\cdot 7854(D^2 - d^2)$	$\frac{D}{2}$	I_x $\frac{\pi(D^4 - d^4)}{64}$ or $\cdot 0491(D^4 - d^4)$	$I_x + Ae_o^2$ or if $e_o = e_x$ $\frac{\pi(5D^4 - 4D^2d^2 - d^4)}{64}$

PROPERTIES OF VARIOUS SECTIONS.

Section.	Area = A.	Distance to Extreme Fibres = e.	Moments of Inertia.	
			About Central Axis = I.	About Parallel Axis O—O = I_o.
	$\frac{\pi R^2}{4}$ or $·7854R^2$	$R - \frac{4R}{3\pi}$ or $·5756R$	I_x $\frac{\pi R^4}{16} - \frac{4R^4}{9\pi}$ or $·0548R^4$	$I_x + Ae_o^2$ or if $e_o = c_x$ $\frac{\pi R^4}{16}$ or $·0625R^4$
	$\frac{\pi R^2}{4}$ or $·7854R^2$	$\frac{R}{\sqrt{2}}$ or $·7071R$	I_U $\frac{\pi R^4}{16} - \frac{R^4}{8}$ or $·0713R^4$	$I_U + Ae_o^2$ or if $e_o = e_U$ $\frac{R^4}{8}$
	$\frac{\pi R^2}{4}$ or $·7854R^2$	$\frac{4R\sqrt{2}}{3\pi}$ or $·6002R$	I_v $\frac{\pi R^4}{16} + \frac{R^4}{8} - \frac{8R^4}{9\pi}$ or $·0385R^4$	$I_v + Ae_o^2$ or if $e_o = e_v$ $\frac{\pi R^4}{16} + \frac{R^4}{8}$ or $·3123R^4$
	$R^2 - \frac{\pi R^2}{4}$ or $·2146R^2$	$\frac{R}{6\left(1 - \frac{\pi}{4}\right)}$ or $·7767R$	I_x $R^4\left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{36 - 9\pi}\right)$ or $·0075R^4$	$I_x + Ae_o^2$ or if $e_o = e_x$ $R^4\left(\frac{1}{3} - \frac{\pi}{16}\right)$ or $·1370R^4$

Modulus of Section $Z = \frac{I}{e}$

Radius of Gyration $k = \sqrt{\frac{I}{A}}$

Moment of Resistance $R = \frac{fI}{e}$

GENERAL FORMULÆ.

Relation of Properties and Formulæ for Flexure.

Notation.

I = moment of inertia about a central axis.
I_0 = " " " " an axis parallel to axis of I.
c_0 = perpendicular distance from axis of I to axis of I_0.
Z = modulus of section for axis of I.
e = perpendicular distance from axis of I to extreme fibre of section.
k = radius of gyration for axis of I.
R = moment of resistance for axis of I.
M = bending moment.
f = intensity of extreme fibre stress.
W = load.
l = effective span.

$$I = Z \times e = A \times k^2 = \frac{M \times e}{f}$$

$$I_0 = I + (A \times c_0{}^2)$$

$$Z = \frac{I}{e} = \frac{M}{f} = \frac{R}{f} \qquad k^2 = \frac{I}{A} \qquad k = \sqrt{\frac{I}{A}}$$

$$f = \frac{M \times e}{I} = \frac{R \times e}{I} = \frac{M}{Z} = \frac{R}{Z}$$

$$M = R = \frac{f \times I}{e} = f \times Z$$

SPECIAL CONDITIONS.

For a beam uniformly loaded and simply supported at each end.

$$W = \frac{8 \times M}{l} = \frac{8 \times f \times I}{l \times e} = \frac{8 \times f \times Z}{l}$$

In addition to above for I, Z, and e in inch units, W in tons, f value 7·5 tons per square inch, M_F in foot tons, and L effective span in feet.

$$W = \frac{5 \times I}{L \times e} = \frac{5 \times Z}{L} \qquad Z = M_F \times 1{\cdot}6.$$

REFERENCE TO GENERAL FORMULÆ.

These general formulæ are algebraic expressions for the following:—

(1)	$Z = \frac{I}{e}$	Modulus of section = moment of inertia about a central axis divided by the perpendicular distance from the central axis to the extreme fibre of the section.
(2)	$Z = \frac{R}{f}$	Modulus of section = moment of resistance divided by extreme fibre stress. ∴ = moment of resistance for unital extreme fibre stress of unity, usually 1 ton per square inch.
(3)	$k = \sqrt{\frac{I}{A}}$	Radius of gyration = square root of moment of inertia about a central axis divided by the area of the section.
(4)	$Io = I + (A \times Co^2)$	Moment of inertia about an axis O – O parallel to the central axis of I = the moment of inertia about the central axis plus the product of the area of the section by the square of the perpendicular distance between the axes.
(5)	$R = M$	For equilibrium the moment of resistance of a section must equal the maximum bending moment due to the external forces.

PROPERTIES OF COMPOUND SECTIONS.

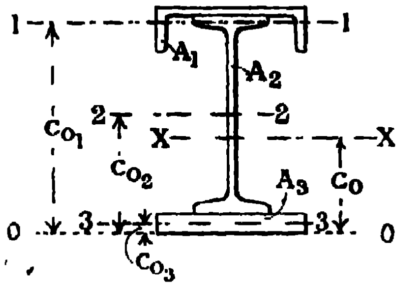
The moments of inertia and other properties of any desired compound section may be ascertained by using the undernoted tabulated values for the simple sections.

Moments of inertia, Part I., pages 17 to 99.
Net moments of inertia, Part IV., page 325.
Moments of inertia of plates, Part IV., pages 325-327.
Positions of central axis, Part V., pages 390-402.

MOMENT OF INERTIA OF AN UNSYMMETRICAL COMPOUND SECTION.

It is first necessary to ascertain the position of the central axis of the compound section about which the moment of inertia is required.

MOMENT OF INERTIA—(*continued*).



As an example, consider the unsymmetrical compound section above.

NOTATION.

X—X = the central axis of the compound section, the position of which is required.

0—0 = a convenient axis parallel to axis X—X. Usually the most convenient position for this axis coincides with an outer edge of the compound section.

A_1, A_2, A_3 = the component areas.

1—1, 2—2, 3—3 = the central axes of A_1, A_2, A_3, parallel to axes X—X and 0—0.

c_{o1}, c_{o2}, c_{o3} = the perpendicular distances from 1—1, 2—2, 3—3 to 0—0.

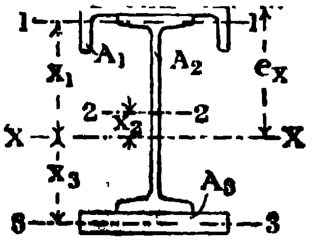
c_o = the required perpendicular distance from axis 0—0 to axis X—X.

Then

$$c_o = \frac{A_1 \times c_{o1} + A_2 \times c_{o2} + A_3 \times c_{o3}}{A_1 + A_2 + A_3}$$

Or: the distance of the centre of area of a plane figure from any point in its plane is equal to the sum of the moments of all the component areas about the point divided by the sum of the component areas.

Having ascertained the position of axis X—X the moment of inertia of the compound section about that axis may now be calculated.



I_1, I_2, I_3 = the moments of inertia of the component areas about the central axes parallel to X—X.

x_1, x_2, x_3 = the perpendicular distances from 1—1, 2—2, 3—3, to X—X.

MOMENT OF INERTIA—(*continued*).

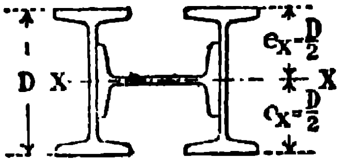
I_x = the required moment of inertia of the compound section about axis X—X.

Then

$$I_x = I_1 + I_2 + I_3 + (A_1 \times x_1^2) + (A_2 \times x_2^2) + (A_3 \times x_3^2)$$

Or: the moment of inertia of a compound section about a central axis is equal to the sum of the moments of inertia of the component areas about their respective parallel central axes plus the sum of the products of each component area into the square of the distance from its central axis to the central axis of the compound section. The foregoing is an application of formula (4) page 304.

MOMENT OF INERTIA AND MODULUS OF SECTION OF A COMPOUND SECTION ABOUT AN AXIS OF SYMMETRY.



If a central axis such as X—X of a compound section coincides with a central axis of each of the component areas or sections it is an axis of symmetry; there are no x distances to consider and:—

$$I_x = I_1 + I_2 + I_3$$

$$Z = \frac{2I_x}{D}$$

DEDUCTIONS FOR RIVET HOLES.

The calculations for ascertaining the exact deductions to be made for rivet holes are extremely laborious.

In practice sufficient accuracy is attained by deducting one rivet hole from each flange for reeled riveting, or two rivet holes from each flange for straight riveting.

The tables of the net moments of inertia of joists and channels and fractional plate widths given on pages 325-327 of this part will be found most convenient for this purpose.

MISCELLANEOUS STRUCTURAL TABLES.

SHEARING AND BEARING VALUES FOR BOLTS AND RIVETS.

Shearing Values at { 5 tons per square inch for **Single Shear.** / 8·75 " " " **Double Shear.** **Bearing Values at 10 tons per square inch.**

Diameter of Bolt or Rivet. Inches.	Area of Bolt or Rivet. Square Inches.	Shearing Values. Single Shear. Tons.	Shearing Values. Double Shear. Tons.	Bearing Values. Tons. Thickness of Plate in Inches. $\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
$\frac{1}{4}$	·0491	·245	·429	·625	·781						
$\frac{3}{8}$	·1104	·552	·966	·937	1·172	1·406					
$\frac{1}{2}$	·1963	·981	1·717	1·250	1·562	1·875	2·187				
$\frac{5}{8}$	·3068	1·534	2·684	1·562	1·953	2·344	2·734	3·125			
$\frac{3}{4}$	·4418	2·209	3·866	*1·875*	2·344	2·812	3·281	3·750	4·687	5·625	
$\frac{7}{8}$	·6013	3·006	5·261	*2·187*	*2·734*	3·281	3·828	4·375	5·469	6·562	
1	·7854	3·927	6·872	*2·500*	*3·125*	*3·750*	4·375	5·000	6·250	7·500	8·750

Shearing Values at { 5·5 tons per square inch for **Single Shear.** / 9·625 " " " **Double Shear.** **Bearing Values at 11 tons per square inch.**

Diameter of Bolt or Rivet. Inches.	Area of Bolt or Rivet. Square Inches.	Shearing Values. Single Shear. Tons.	Shearing Values. Double Shear. Tons.	Bearing Values. Tons. Thickness of Plate in Inches. $\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
$\frac{1}{4}$	·0491	·270	·472	·687	·859						
$\frac{3}{8}$	·1104	·607	1·062	1·031	1·289	1·547					
$\frac{1}{2}$	·1963	1·079	1·889	1·375	1·719	2·062	2·406				
$\frac{5}{8}$	·3068	1·687	2·953	1·719	2·148	2·578	3·008	3·437			
$\frac{3}{4}$	·4418	2·430	4·252	*2·062*	2·578	3·094	3·609	4·125	5·156	6 187	
$\frac{7}{8}$	·6013	3·307	5·787	*2·406*	*3·008*	3·609	4·211	4·812	6·015	7·219	
1	·7854	4·320	7·559	*2·750*	*3·437*	*4·125*	4·812	5·500	6·875	8·250	9·625

SHEARING AND BEARING VALUES FOR BOLTS AND RIVETS.

Shearing Values at { 6 tons per square inch for **Single Shear.**
{ 10·5 " " " **Double Shear.**
Bearing Values at 12 tons per square inch.

Diameter of Bolt or Rivet. Inches.	Area of Bolt or Rivet. Square Inches.	Shearing Values. Single Shear. Tons.	Shearing Values. Double Shear. Tons.	Bearing Values. Tons. Thickness of Plate in Inches. ¼	5/16	⅜	7/16	½	⅝	¾	⅞
¼	0491	·294	·515	·750	·937						
⅜	·1101	·662	1·159	**1·125**	1·406	1·687					
½	1963	1·178	2 061	**1·500**	**1·875**	2·250	2·625				
⅝	·3068	1·841	3·221	**1·875**	**2·344**	**2·812**	3·281	3·750			
¾	·4418	2·651	4·639	*2·250*	**2·812**	**3·375**	**3·937**	**4·500**	5·625	6·750	
⅞	·6013	3·608	6·313	*2·625*	*3·281*	**3·937**	**4·594**	**5·250**	6·562	7·875	
1	·7854	4·712	8·247	*3·000*	*3·750*	*4·500*	**5·250**	**6·000**	**7·500**	9·000	10·50

In the above tables double shear is taken at 1·75 times single shear, and the bearing value at twice single shear.

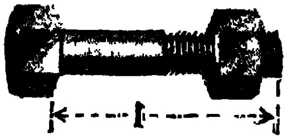
Bearing Values printed in ordinary type are greater than double shear for the corresponding diameters. In these cases the shearing values are the determining factors.

Bearing Values printed in prominent type are greater than single and less than double shear for the corresponding diameters, so that in case of

(*a*) Single shear, the shearing value is the criterion.

(*b*) Double shear, the bearing value " "

Bearing Values printed in italics are less than single shear. In these cases the bearing values are the determining factors.



WHITWORTH STANDARD BOLTS AND NUTS.

Hexagon Head and Nut and Round Neck.

APPROXIMATE WEIGHT IN LBS. OF ONE BOLT AND NUT.

Length l inches.	DIAMETER IN INCHES.										
	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
1	·031	·092	·200	·369	·613						
1⅛	·033	·096	·207	·380	·628						
1¼	·035	·100	·214	·391	·644	·989					
1⅜	·036	·103	·221	·403	·661	1·011					
1½	·038	·108	·228	·414	·677	1·033	1·489				
1⅝	·040	·112	·236	·425	·694	1·055	1·518				
1¾	·042	·116	·243	·436	·709	1·077	1·546	2·118			
1⅞	·044	·120	·250	·448	·725	1·099	1·575	2·177			
2	·046	·124	·257	·458	·742	1·121	1·604	2·214	2·951	3·851	
2⅛	·048	·128	·264	·470	·758	1·143	1·632	2·251	2·996	3·904	
2¼	·050	·132	·271	·481	·773	1·165	1·661	2·286	3·041	3·959	5·032
2⅜	·051	·136	·279	·492	·790	1·187	1·690	2·323	3·085	4·014	5·097
2½	·053	·140	·286	·504	·806	1·209	1·718	2·359	3·131	4·067	5·161
2¾	·056	·149	·300	·526	·838	1·252	1·776	2·432	3·220	4·176	5·290
3	·060	·156	·315	·549	·871	1·296	1·833	2·468	3·309	4·285	5·420
3¼	·064	·164	·329	·571	·903	1·340	1·891	2·577	3·398	4·393	5·549
3½	·067	·173	·343	·592	·935	1·384	1·928	2·650	3·489	4·502	5·675
3¾	·071	·180	·358	·616	·968	1·429	2·005	2·722	3·578	4·610	5·807

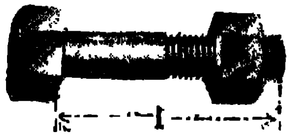
	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
For each additional inch length of Shank add.	·014	·031	·055	·085	·123	·176	·218	·276	·331	·418	·491

TO ASCERTAIN THE WEIGHT OF ANY BOLT AND NUT HAVING OTHER FORMS OF HEAD AND NUT, TAKE THE WEIGHT AS SHOWN ABOVE AND ADD AS FOLLOWS :—

For square head,	·0009	·0033	·0079	·0156	·0274	·0427	·0637	·0843	·1225	·1655	·2154
For square nut,	·0011	·0038	·0091	·0180	·0308	·0493	·0735	·0974	·1410	·1912	·2487

WHITWORTH STANDARD BOLTS AND NUTS.

Hexagon Head and Nut and Round Neck.



APPROXIMATE WEIGHT IN LBS. OF ONE BOLT AND NUT.

Length in Inches.	DIAMETER IN INCHES.										
	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
4	·074	·189	·372	·638	1·000	1·473	2·062	2·795	3·667	4·718	5·936
4¼	·078	·197	·386	·660	1·032	1·517	2·119	2·867	3·756	4·827	6·065
4½	·081	·205	·401	·683	1·064	1·561	2·177	2·941	3·846	4·936	6·195
4¾	·085	·213	·415	·705	1·097	1·605	2·234	3·013	3·936	5·044	6·323
5	·089	·221	·429	·727	1·129	1·649	2·292	3·085	4·025	5·152	6·452
5¼	·092	·229	·444	·750	1·161	1·692	2·348	3·156	4·114	5·261	6·581
5½	·096	·237	·458	·772	1·193	1·736	2·406	3·230	4·204	5·369	6·710
5¾	·099	·245	·472	·795	1·226	1·786	2·464	3·304	4·293	5·478	6·839
6	·103	·254	·487	·817	1·283	1·824	2·501	3·376	4·383	5·587	6·968
6½	·110	·269	·515	·863	1·323	1·913	2·635	3·521	4·562	5·804	7·227
7	·117	·285	·544	·907	1·388	2·001	2·749	3·666	4·741	6·020	7·485
7½	·124	·302	·573	·952	1·452	2·087	2·865	3·812	4·920	6·238	7·743
8		·319	·601	·997	1·517	2·176	2·973	3·957	5·098	6·455	8·001
8½		·334	·631	1·041	1·581	2·264	3·094	4·102	5·278	6·671	8·259
9			·659	1·086	1·646	2·353	3·208	4·248	5·456	6·888	8·517
9½			·687	1·131	1·710	2·441	3·323	4·393	5·636	7·106	8·775
10				1·177	1·774	2·528	3·437	4·531	5·814	7·322	9·083
10½				1·221	1·839	2·616	3·553	4·084	5·993	7·529	9·292
11					1·904	2·704	3·667	4·828	6·172	7·757	9·550
11½						2·793	3·782	4·973	6·351	7·973	9·808
12							3·896	5·119	6·531	8·101	10·066
	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
For each additional inch length of Shank add.	·014	·031	·055	·085	·123	·176	·218	·276	·381	·413	·491

TO ASCERTAIN THE WEIGHT OF ANY BOLT AND NUT HAVING OTHER FORMS OF HEAD AND NUT, TAKE THE WEIGHT AS SHEWN ABOVE AND ADD AS FOLLOWS:—

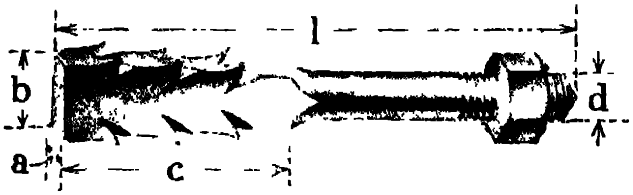
For Square Head,	·0009	·0033	·0079	·0156	·0274	·0427	·0637	·0843	·1225	·1655	·2154
For Square Nut,	·0011	·0038	·0091	·0180	·0308	·0493	·0735	·0974	·1410	·1912	·2437

BOLTS AND NUTS.

Whitworth's Standard Sizes.

Diameter of Bolt. Inches.		Number of Threads per inch.	Diameter at Bottom of Thread.	Distances in inches over		Thickness of Bolt Head. Inches.	Sectional Area at Bottom of Thread. Sq. inches.
Fraction.	Decimal.			Flats.	Corners.		
¼	·250	20	·186	·525	·606	·219	·027
⅜	·375	16	·295	·709	·819	·328	·068
½	·500	12	·393	·919	1·061	·437	·121
⅝	·625	11	·508	1·101	1·271	·547	·203
¾	·750	10	·622	1·301	1·502	·656	·304
⅞	·875	9	·733	1·479	1·707	·766	·422
1	1·000	8	·840	1·670	1·928	·875	·554
1⅛	1·125	7	·942	1·860	2·148	·984	·697
1¼	1·250	7	1·067	2·048	2·365	1·094	·894
1⅜	1·375	6	1·161	2·215	2·557	1·203	1·059
1½	1·500	6	1·286	2·413	2·787	1·312	1·300

LEWIS BOLTS AND NUTS.



Diameter d inches.	Overall Length l inches.	Taper Length c inches.	Base.		Diameter d inches.	Overall Length l inches.	Taper Length c inches.	Base.	
			a inches.	b inches.				a inches.	b inches.
½	5	3	½	⅞	1	8	4½	1	1⅝
⅝	6	3	⅝	1⅛	1⅛	9	5	1⅛	1⅞
¾	6	3	¾	1¼	1¼	10	6	1¼	2⅛
⅞	7	3½	⅞	1½	1½	12	7	1½	2½

GAS TUBING.

Approximate Weights and Sizes.

Nominal Bore, inches, - - - - - - -	¾	1	1¼	1½	2
Thickness { S.W.G., - - - - - - -	11	10	9	8	8
Thickness { Inches, - - - - - - -	·116	·128	·144	·160	·160
No. of Threads per inch (Whitworth), - -	14	11	11	11	11
Weight per foot in lbs., - - - - - -	1·18	1·79	2·52	2·97	4·48

HEXAGON COUPLING BOXES.

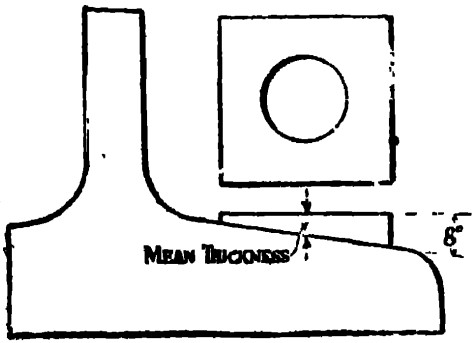
Screwed Right and Left Hand Thread.

Diameter. Inches.	Length of Box. Inches.	Length of Ends. Inches.	Diameter. Inches.	Length of Box. Inches.	Length of Ends. Inches.
¼	1½	2½	1	7	8
5/16	2½	3	1⅛	8	8
⅜	3	4½	1¼	9	9
7/16	4	6	1⅜	9½	10
½	4½	6	1½	10	12
⅝	5	6	1¾	11	12
¾	6	7	2	12	12
⅞	6½	7			

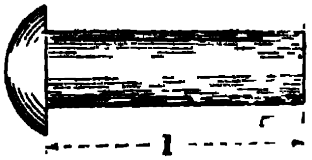
ORDINARY WASHERS.

Diameter of Bolt. Inches.	Outside Diameter of Washer. Inches.	Thickness of Washer. Inches.	Weight per 100. Lbs.	Diameter of Bolt. Inches.	Outside Diameter of Washer. Inches.	Thickness of Washer. Inches.	Weight per 100. Lbs.
½	1⅛	⅛	2½	1	2⅛	3/16	14
⅝	1⅜	⅛	4	1⅛	2⅜	3/16	17½
¾	1⅝	⅛	5½	1¼	2⅝	3/16	21½
⅞	1⅞	⅛	7½	1⅜	2⅞	3/16	26
				1½	3⅛	3/16	30½

SQUARE BEVELLED WASHERS.



Diameter of Bolt. Inches.	Side of Square. Inches.	Mean Thickness. Inches.	Weight per 100. Lbs.
½	1⅛	3/16	6
⅝	1⅜	3/16	8½
¾	1 9/16	3/16	10½
⅞	1⅞	3/16	15½
1	2⅛	3/16	20



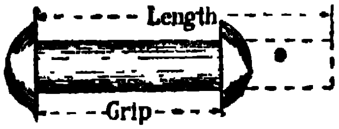
STEEL CUP HEADED RIVETS.

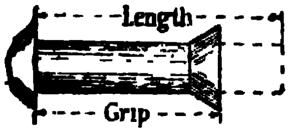
Approximate Weights in Lbs. per 100.

Length l Inches.	DIAMETERS IN INCHES.						Length l Inches.
	⅜	½	⅝	¾	⅞	1	
1	4·89	9·74					1
1⅛	5·28	10·43					1⅛
1¼	5·67	11·13					1¼
1⅜	6·06	11·82					1⅜
1½	6·45	12·52	21·20	32·86			1½
1⅝	6·84	13·22	22·28	34·42			1⅝
1¾	7·23	13·91	23·37	35·98			1¾
1⅞	7·62	14·61	24·46	37·55			1⅞
2	8·01	15·30	25·55	39·11	56·43	77·88	2
2⅛	8·40	16·00	26·63	40·68	58·56	80·66	2⅛
2¼	8·79	16·70	27·72	42·44	60·68	83·44	2¼
2⅜	9·18	17·39	28·81	43·81	62·81	86·22	2⅜
2½	9·57	18·09	29·90	45·37	64·94	89·01	2½
2⅝	9·96	18·79	30·98	46·94	67·07	91·79	2⅝
2¾	10·35	19·48	32·07	48·50	69·20	94·57	2¾
2⅞	10·74	20·18	33·15	50·07	71·33	97·35	2⅞
3		20·87	34·24	51·63	73·46	100·13	3
3⅛		21·57	35·32	53·19	75·59	102·91	3⅛
3¼		22·27	36·41	54·76	77·72	105·69	3¼
3⅜		22·96	37·50	56·32	79·85	108·47	3⅜
3½			38·59	57·89	81·98	111·26	3½
3⅝			39·67	59·45	84·11	114·04	3⅝
3¾			40·76	61·02	86·23	116·82	3¾
3⅞			41·85	62·58	88·36	119·60	3⅞
4				64·15	90·49	122·38	4
4⅛				65·71	92·62	125·16	4⅛
4¼				67·28	94·75	127·94	4¼
4⅜				68·84	96·88	130·72	4⅜
4½					99·01	133·51	4½
4⅝					101·14	136·29	4⅝
4¾					103·27	139·07	4¾
4⅞					105·40	141·85	4⅞
5					107·53	144·63	5
5⅛					109·66	147·41	5⅛
5¼					111·78	150·19	5¼
5⅜						152·97	5⅜
5½						155·76	5½
5⅝						158·54	5⅝
5¾						161·32	5¾
5⅞						164·10	5⅞
6						166·88	6
Weight Per 100 Heads, lbs.	1·76	4·17	8·15	14·08	22·86	33·38	Weight Per 100 Heads, lbs.
For each additional Inch Length of Shank add per 100.	3·13	5·57	8·70	12·52	17·08	22·25	For each additional Inch Length of Shank add per 100.

MACHINE RIVETING.

Lengths of Rivets for Varying Grips.





Grip. Inches.	Diameters in Inches.				Grip. Inches.	Diameters in Inches.			
	½	⅝	¾	⅞		½	⅝	¾	⅞
	Lengths in Inches.					Lengths in Inches.			
¾	1¾	2			¾	1⅜	1½		
⅞	1⅞	2⅛			⅞	1½	1⅝		
1	2	2¼	2⅜	2½	1	1⅝	1¾	1¾	1⅞
1⅛	2⅛	2⅜	2½	2⅝	1⅛	1¾	1⅞	1⅞	2
1¼	2¼	2½	2⅝	2¾	1¼	1⅞	2	2	2⅛
1⅜	2⅜	2⅝	2¾	2⅞	1⅜	2	2⅛	2⅛	2¼
1½	2⅝	2⅞	3	3⅛	1½	2⅛	2¼	2⅜	2⅜
1⅝	2¾	3	3⅛	3¼	1⅝	2¼	2⅜	2½	2½
1¾	2⅞	3⅛	3¼	3⅜	1¾	2⅜	2½	2⅝	2⅝
1⅞	3	3¼	3⅜	3½	1⅞	2½	2⅝	2¾	2¾
2	3⅛	3⅜	3½	3⅝	2	2⅝	2¾	2⅞	2⅞
2⅛	3¼	3½	3⅝	3¾	2⅛	2¾	2⅞	3	3
2¼	3⅜	3⅝	3¾	3⅞	2¼	2⅞	3	3⅛	3⅛
2⅜	3½	3¾	3⅞	4	2⅜	3	3⅛	3¼	3¼
2½	3⅝	3⅞	4	4⅛	2½	3⅛	3¼	3⅜	3⅜
2⅝	3¾	4	4⅛	4¼	2⅝	3¼	3⅜	3½	3½
2¾	3⅞	4⅛	4¼	4½	2¾	3⅜	3½	3⅝	3⅝
2⅞	4	4¼	4½	4⅝	2⅞	3½	3⅝	3¾	3¾
3	4¼	4½	4⅝	4¾	3	3¾	3⅞	3⅞	4
3⅛		4⅝	4¾	4⅞	3⅛		4	4	4⅛
3¼		4¾	4⅞	5	3¼		4⅛	4⅛	4¼
3⅜		4⅞	5	5⅛	3⅜		4¼	4¼	4⅜
3½		5	5⅛	5¼	3½		4⅜	4⅜	4½
3⅝		5⅛	5¼	5⅜	3⅝		4½	4½	4⅝
3¾		5¼	5⅜	5½	3¾		4⅝	4⅝	4¾
3⅞		5⅜	5½	5⅝	3⅞		4¾	4¾	4⅞
4			5⅝	5¾	4			4⅞	5
4⅛			5¾	5⅞	4⅛			5	5⅛
4¼			5⅞	6	4¼			5⅛	5¼
4⅜			6	3	4⅜			5¼	5⅜
4½			6⅛	3⅜	4½			5½	5½
4⅝			6⅜	6½	4⅝			5⅝	5⅝
4¾			6½	6⅝	4¾			5¾	5¾
4⅞			6⅝	6¾	4⅞			5⅞	5⅞
5			6¾	6⅞	5			6	6

For Hand Riveting deduct ¼-in. from above Lengths.

GALVANISED CORRUGATED SHEETS.

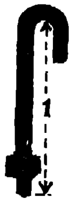
SIZES AND APPROXIMATE WEIGHTS IN LBS. PER SHEET.

Size, Length × Breadth, Feet.	Gauge. 18	20	22	24	26	Size, Length × Breadth, Feet	Gauge. 18	20	22	24	26
4 × 2	20	16	13½	11	8¼	8 × 2	41¾	32	26¾	22	16½
4½ × "	23½	18	15	12½	9¼	8½ × "	44½	34	28½	23½	17½
5 × "	26	20	17	14	10½	9 × "	47	36	30	25	18½
5½ × "	27¾	22	18½	15½	11½	10 × "	52	40	34	28	21
6 × "	31¼	24	20¼	16½	12½						
6½ × "	34	26	21¾	17¾	13½	6 × 2½	37½	29	24½	20	15
7 × "	36½	28	23½	19	14½	7 × "	44	34	28½	23	17½
7½ × "	39¼	30	25	20½	15½	8 × "	50	38½	32½	26½	20
1 sq. foot.	2·41	1·85	1·55	1·29	0·95	100 sq. feet.*	241	185	155	129	95

Additional Weights in Lbs. per Square.*	Gauge. 18	20	22	24	26
For single side lap and 6-in. end lap, . .	32·1	24·7	20	17·2	12·7
For double " " 6-in. " " . .	62·3	47·8	40	33·3	24·5

GALVANISED SHEET FITTINGS.

SIZES AND APPROXIMATE WEIGHTS IN LBS. PER GROSS AND SQUARE.*



Hook Bolts.

Length, 1 inches, -	3½		4		4½		5	
Diameter, inches, ...	5/16	3/8	5/16	3/8	5/16	3/8	5/16	3/8
Weight per gross, ...	18·7	24·9	20·4	28 0	22·4	32·0	24·9	37·3
Weight per square (4 per sq. yd.),	5·8	7·7	6·8	8·6	6·9	9·9	7·7	11·5

Washers.

For ¼-in. diameter bolts

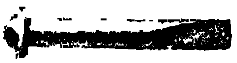
Weights per Gross.

1·96 lbs. 5·22 lbs.

Weights per Square.

·81 lb. - 3·0 lbs.

Roofing Screws.



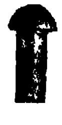
¼-in diameter.

2½	3	Length, inches.	2½	3
5·1	5·9	Weight per Gross.	5·3	7·0
2·1	2·4	Weight per Square.	2·2	2·9

Sheeting Bolts. Cup Header Rivets.

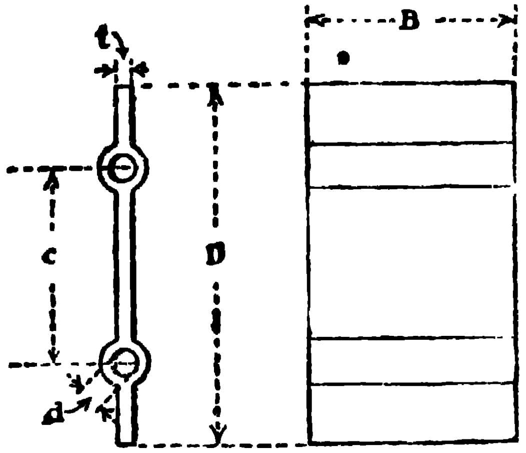
¼-in. diameter.

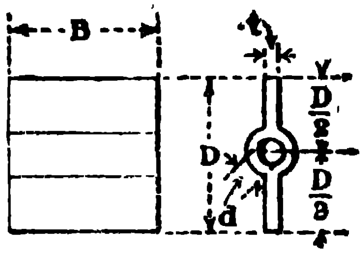
¾	1¼	1½	Length, inches.	⅜	½	⅝
3·6	4·7	5·1	Weight per Gross.	2·0	2·15	2·3
1·5	2·0	2·2	Weight per Square.	·81	·87	·93



*1 "square" = 100 square feet.

CAST IRON SEPARATORS.





Steel Joist.		Bolts.			Cast Iron Separator.					Steel Joist.
						Holes.				
Size, inches.	Centres of Webs, inches.	Size, inches.	Weight, lbs.	Type.	Size, D × B × t inches.	Centres, inches c.	Dia., inches d.	Weight, lbs.	Weight, per inch width, lbs.	Size, inches.
24 × 7½	8·10	9¾ × ⅞	2·48	1	19½ × 7½ × ⅝	12	⅞	26½	3·53	24 × 7½
20 × 7½	8·10	9¾ × ⅞	2·48	1	16¼ × 7½ × ⅝	10	⅞	22	2·94	20 × 7½
18 × 7	7·55	9¼ × ⅞	2·39	1	13½ × 7 × ⅝	9	⅞	17½	2·50	18 × 7
16 × 6	6·55	8 × ¾	1·52	1	12 × 6 × ½	6½	¾	12	2·00	16 × 6
15 × 6	6·50	7⅞ × ¾	1·50	1	10½ × 6 × ½	6	¾	11	1·83	15 × 6
15 × 5	5·42	6¾ × ¾	1·35	1	10½ × 5 × ½	6	¾	9	1·80	15 × 5
14 × 6*a*	6·50	7⅞ × ¾	1·50	1	10½ × 6 × ½	5¾	¾	11	1·83	14 × 6*a*
14 × 6*b*	6·40	7¾ × ¾	1·48	1	10½ × 6 × ½	5¾	¾	11	1·83	14 × 6
12 × 6*a*	6·50	7⅞ × ¾	1·50	1	8½ × 6 × ½	5	¾	9	1·50	12 × 6*a*
12 × 6*b*	6·40	7¾ × ¾	1·48	1	8½ × 6 × ½	5	¾	9	1·50	12 × 6*b*
12 × 5	5·60	6⅞ × ¾	1·37	1	8½ × 5¼ × ½	5	¾	8	1·52	12 × 5
10 × 6	6·40	7¾ × ¾	1·48	1	7 × 6 × ½	4	¾	8	1·33	10 × 6
10 × 5	5·61	6⅞ × ¾	1·37	1	7 × 5¼ × ½	4	¾	7	1·33	10 × 5
9 × 4	4·55	5¾ × ¾	1·23	1	7 × 4¼ × ½	3	¾	5½	1·29	9 × 4
8 × 6	6·44	7¾ × ¾	1·48	1	5 × 6 × ½	3	¾	6½	1·08	8 × 6
8 × 5	5·60	6⅞ × ¾	1·37	1	5 × 5¼ × ½	3	¾	5½	1·05	8 × 5
8 × 4	4·53	5¾ × ¾	1·23	1	5 × 4¼ × ½	3	¾	4½	1·06	8 × 4
7 × 4	4·50	5⅝ × ¾	1·21	2	5 × 4¼ × ½		¾	3½	·82	7 × 4
6 × 5	5·41	6¾ × ¾	1·35	2	3 × 5 × ½		¾	3	·60	6 × 5
6 × 4½	5·12	6⅝ × ¾	1·31	2	3 × 4¾ × ½		¾	3	·66	6 × 4½
6 × 3	3·51	4⅝ × ¾	1·08	2	3 × 3¼ × ½		¾	2	·61	6 × 3

SECTIONAL AREAS OF STEEL ANGLES IN SQUARE INCHES.

Breadths of Flanges added in inches.	THICKNESS OF ANGLE IN INCHES.											
	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	⅞	1
2½	·43	·56										
2¾	·48	·63										
3	·53	·69										
3¼	·57	·75	·92									
3½	·62	·81	1·00	1·17								
3¾	·67	·88	1·07	1·27								
4	·72	·94	1·15	1·36								
4¼	·76	1·00	1·23	1·45								
4½	·81	1·06	1·31	1·55	1·78							
4¾	·86	1·13	1·39	1·64	1·88	2·13						
5	·90	1·19	1·46	1·73	2·00	2·25	2·50					
5¼	·95	1·25	1·54	1·83	2·11	2·38	2·64					
5½	1·00	1·31	1·62	1·92	2 21	2·50	2 78	3·05				
5¾	1·04	1·38	1·70	2·02	2·32	2·63	2·92	3·20				
6	1·09	1·44	1·78	2·11	2·43	2·75	3·06	3·36	3·65	3·94		
6¼	1·14	1·50	1·86	2·20	2 54	2·88	3·20	3·52	3·82	4·13		
6½	1·18	1·56	1·93	2 30	2·65	3·00	3·34	3·67	4·00	4·31		
6¾	1·23	1·63	2·01	2·39	2·76	3·13	3·48	3·83	4·17	4·50		
7	1·28	1·69	2·09	2·48	2·87	3·25	3·62	3·98	4·34	4·69		
7¼	1·32	1·75	2·17	2·58	2·98	3·38	3·76	4·14	4·51	4·89		
7½	1·37	1·81	2·25	2·67	3·09	3·50	3·90	4·30	4·68	5·06		
7¾	1·42	1·88	2·32	2·77	3·20	3·63	4·04	4·45	4·86	5·26		
8	1·47	1·94	2·40	2·86	3·31	3·75	4·18	4·61	5·03	5·44		
8¼	1·51	2·00	2·48	2·95	3·42	3·88	4·32	4·77	5·20	5·63		
8½	1·56	2·06	2·56	3·05	3·53	4·00	4·46	4·92	5·37	5·81		
8¾	1·61	2·13	2·64	3·14	3·64	4·13	4·61	5·08	5·54	6·00		
9			2·72	3·23	3·75	4·25	4·75	5·23	5·71	6·19	7·11	
9¼			2·79	3·33	3·86	4·38	4·89	5·39	5·89	6·38	7·33	
9½			2·87	3·42	3·97	4·50	5·03	5·55	6·06	6·57	7·55	
9¾			2·95	3·52	4·07	4·63	5·17	5·70	6·23	6·75	7·77	
10				3·61	4·18	4·75	5·31	5·86	6·40	6·94	7·98	9·00
10¼				3·70	4·29	4·88	5·45	6·02	6·57	7·13	8·20	9·25
10½				3·80	4·40	5·00	5·59	6·17	6·75	7·31	8·42	9·50
10¾				3·89	4·51	5·13	5·73	6·33	6·92	7·50	8·64	9·75
11				3·98	4·62	5·25	5·87	6·48	7·09	7·69	8·86	10·00
11¼				4·08	4·73	5·38	6·01	6·64	7·26	7·88	9·08	10·25
11½				4·17	4·84	5·50	6·15	6·80	7·43	8·06	9·30	10·50
11¾				4·27	4·95	5·63	6·29	6·95	7·61	8·25	9·52	10·75
12				4·36	5·06	5·75	6·43	7·11	7·78	8·44	9·73	11·00

REDPATH, BROWN & CO., LIMITED.

WEIGHTS OF STEEL ANGLES IN LBS. PER LINEAL FOOT.

Breadths of Flanges added in inches.	•THICKNESS OF ANGLE IN INCHES.											
	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
2½	1·47	1·91										
2¾	1·63	2·13										
3	1·79	2·34										
3¼	1·95	2·55	3·12									
3½	2·11	2·76	3·39	3·98								
3¾	2·27	2·98	3·65	4·30								
4	2·43	3·19	3·92	4·62								
4¼	2·59	3·40	4·18	4·94								
4½	2·75	3·61	4·45	5·26	6·04							
4¾	2·91	3·83	4·72	5·58	6·42	7·23						
5	3·07	4·04	4·98	5·90	6·79	7·65	8·49					
5¼	3·23	4·25	5·25	6·22	7·16	8·08	8·97					
5½	3·39	4·46	5·51	6·53	7·53	8·50	9·44	10·36				
5¾	3·55	4·68	5·78	6·85	7·90	8·93	9·92	10·89				
6	3·71	4·89	6·04	7·17	8·27	9·35	10·40	11·42	12·42	13·39		
6¼	3·87	5·10	6·31	7·49	8·65	9·78	10·88	11·95	13·00	14·03		
6½	4·02	5·31	6·57	7·81	9·02	10·20	11·36	12·48	13·59	14·66		
6¾	4·18	5·53	6·84	8·13	9·39	10·63	11·83	13·02	14·17	15·30		
7	4·34	5·74	7·11	8·45	9·76	11·05	12·31	13·55	14·76	15·94		
7¼	4·50	5·95	7·37	8·77	10·13	11·48	12·79	14·08	15·34	16·58		
7½	4·66	6·16	7·64	9·08	10·51	11·90	13·27	14·61	15·92	17·21		
7¾	4·82	6·38	7·90	9·40	10·88	12·33	13·75	15·14	16·51	17·85		
8	4·98	6·59	8·17	9·72	11·25	12·75	14·22	15·67	17·09	18·49		
8¼	5·14	6·80	8·43	10·04	11·62	13·18	14·70	16·20	17·68	19·13		
8½	5·30	7·01	8·70	10·36	11·99	13·60	15·18	16·73	18·26	19·76		
8¾	5·46	7·23	8·97	10·68	12·37	14·03	15·66	17·27	18·85	20·40		
9			9·28	11·00	12·74	14·45	16·14	17·80	19·43	21·04	24·17	
9¼			9·50	11·32	13·11	14·88	16·62	18·33	20·02	21·68	24·92	
9½			9·76	11·63	13·48	15·30	17·09	18·86	20·60	22·31	25·66	
9¾			10·03	11·95	13·85	15·73	17·57	19·39	21·18	22·95	26·40	
10				12·27	14·22	16·15	18·05	19·92	21·77	23·59	27·15	30·60
10¼				12·59	14·60	16·58	18·53	20·45	22·35	24·23	27·89	31·45
10½				12·91	14·97	17·00	19·01	20·98	22·94	24·86	28·63	32·30
10¾				13·23	15·34	17·43	19·48	21·52	23·52	25·50	29·38	33·15
11				13·55	15·71	17·85	19·96	22·05	24·11	26·14	30·12	34·00
11¼				13·87	16·08	18·38	20·44	22·58	24·69	26·78	30·87	34·85
11½				14·18	16·46	18·70	20·92	23·11	25·27	27·41	31·61	35·70
11¾				14·50	16·83	19·13	21·40	23·64	25·86	28·05	32·35	36·55
12				14·82	17·20	19·55	21·87	24·17	26·44	28·69	33·10	37·40

FLAT ROLLED STEEL.

Sectional Areas in Square Inches.

Breadth in Inches.	THICKNESS IN FRACTIONS OF AN INCH.																
	¼	5/16	⅜	7/16	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
1	·250	·312	·375	·437	·500	·625	·750	·875	1·00								
1⅛	·281	·351	·421	·492	·562	·703	·843	·984	1·12								
1¼	·312	·390	·468	·546	·625	·781	·937	1·09	1·25	1·40							
1⅜	·345	·429	·515	·601	·687	·859	1·03	1·20	1·37	1·54	1·72						
1½	·375	·468	·562	·656	·750	·937	1·12	1·31	1·50	1·68	1·87	2·06					
1⅝	·406	·507	·609	·710	·812	1·01	1·22	1·42	1·62	1·82	2·03	2·23	2·44				
1¾	·437	·546	·656	·765	·875	1·09	1·31	1·53	1·75	1·97	2·18	2·40	2·62	2·84			
1⅞	·469	·586	·703	·820	·937	1·17	1·40	1·64	1·87	2·11	2·34	2·56	2·81	3·04	3·28		
2	·500	·625	·750	·875	1·00	1·25	1·50	1·75	2·00	2·25	2·50	2·75	3·00	3·25	3·50	3·75	
2⅛	·531	·664	·796	·929	1·06	1·32	1·59	1·86	2·12	2·39	2·65	2·92	3·18	3·45	3·71	3·98	4·25
2¼	·562	·703	·843	·984	1·12	1·40	1·68	1·97	2·25	2·53	2·81	3·09	3·37	3·65	3·93	4·21	4·50
2⅜	·594	·743	·890	1·04	1·18	1·48	1·78	2·07	2·37	2·67	2·96	3·26	3·56	3·86	4·15	4·45	4·75
2½	·625	·781	·937	1·09	1·25	1·56	1·87	2·18	2·50	2·81	3·12	3·43	3·75	4·06	4·37	4·68	5·00
2⅝	·656	·820	·984	1·15	1·31	1·64	1·96	2·29	2·62	2·95	3·28	3·61	3·93	4·26	4·59	4·92	5·25
2¾	·687	·859	1·03	1·20	1·37	1·72	2·06	2·40	2·75	3·09	3·43	3·78	4·12	4·47	4·81	5·15	5·50
2⅞	·719	·898	1·07	1·26	1·43	1·80	2·15	2·51	2·87	3·23	3·59	3·95	4·31	4·67	5·03	5·39	5·75
3	·750	·937	1·12	1·31	1·50	1·87	2·25	2·62	3·00	3·37	3·75	4·12	4·50	4·87	5·25	5·62	6·00
3¼	·812	1·01	1·22	1·42	1·62	2·03	2·43	2·84	3·25	3·65	4·06	4·46	4·87	5·28	5·68	6·09	6·50
3½	·875	1·09	1·31	1·53	1·75	2·19	2·62	3·06	3·50	3·93	4·37	4·81	5·25	5·68	6·12	6·56	7·00
3¾	·937	1·17	1·40	1·64	1·87	2·34	2·81	3·28	3·75	4·21	4·68	5·15	5·62	6·09	6·56	7·03	7·50
4	1·00	1·25	1·50	1·75	2·00	2·50	3·00	3·50	4·00	4·50	5·00	5·50	6·00	6·50	7·00	7·50	8·00
4¼	1·06	1·32	1·59	1·85	2·12	2·65	3·18	3·71	4·25	4·78	5·31	5·84	6·37	6·90	7·43	7·97	8·50
4½	1·12	1·40	1·68	1·97	2·25	2·81	3·37	3·93	4·50	5·06	5·62	6·18	6·75	7·31	7·87	8·43	9·00
4¾	1·19	1·48	1·78	2·07	2·37	2·96	3·56	4·15	4·75	5·34	5·93	6·53	7·12	7·71	8·31	8·90	9·50
5	1·25	1·56	1·87	2·18	2·50	3·12	3·75	4·37	5·00	5·62	6·25	6·87	7·50	8·12	8·75	9·37	10·0
5¼	1·31	1·64	1·96	2·29	2·62	3·28	3·93	4·59	5·25	5·91	6·56	7·21	7·87	8·53	9·18	9·84	10·5
5½	1·37	1·71	2·06	2·40	2·75	3·43	4·12	4·81	5·50	6·19	6·87	7·56	8·25	8·93	9·62	10·3	11·0
5¾	1·43	1·79	2·15	2·51	2·87	3·59	4·31	5·03	5·75	6·47	7·18	7·90	8·62	9·34	10·0	10·8	11·5
6	1·50	1·87	2·25	2·62	3·00	3·75	4·50	5·25	6·00	6·75	7·50	8·25	9·00	9·75	10·5	11·2	12·0
6½	1·62	2·03	2·44	2·84	3·25	4·06	4·87	5·68	6·50	7·31	8·12	8·93	9·75	10·5	11·3	12·2	13·0
7	1·75	2·18	2·62	3·06	3·50	4·37	5·25	6·12	7·00	7·87	8·75	9·62	10·5	11·3	12·2	13·1	14·0
7½	1·87	2·34	2·81	3·28	3·75	4·68	5·62	6·56	7·50	8·43	9·37	10·3	11·2	12·2	13·1	14·0	15·0
8	2·00	2·50	3·00	3·50	4·00	5·00	6·00	7·00	8·00	9·00	10·0	11·0	12·0	13·0	14·0	15·0	16·0
8½	2·12	2·65	3·18	3·71	4·25	5·31	6·37	7·43	8·50	9·56	10·6	11·7	12·7	13·8	14·8	15·9	17·0
9	2·25	2·81	3·37	3·93	4·50	5·62	6·75	7·87	9·00	10·2	11·2	12·3	13·5	14·6	15·7	16·8	18·0
9½	2·37	2·96	3·56	4·15	4·75	5·93	7·12	8·31	9·50	10·7	11·8	13·1	14·2	15·4	16·6	17·8	19·0
10	2·50	3·12	3·75	4·37	5·00	6·25	7·50	8·75	10·0	11·2	12·5	13·7	15·0	16·2	17·5	18·7	20·0
10½	2·62	3·28	3·93	4·59	5·25	6·56	7·87	9·18	10·5	11·8	13·1	14·4	15·7	17·0	18·3	19·7	21·0
11	2·75	3·43	4·12	4·81	5·50	6·87	8·25	9·62	11·0	12·4	13·7	15·1	16·5	17·8	19·2	20·6	22·0
11½	2·87	3·59	4·31	5·03	5·75	7·18	8·62	10·1	11·5	12·9	14·3	15·8	17·2	18·6	20·1	21·5	23·0
12	3·00	3·75	4·50	5·25	6·00	7·50	9·00	10·5	12·0	13·5	15·0	16·5	18·0	19·5	21·0	22·5	24·0

FLAT ROLLED STEEL.

Weight per Lineal Foot in Lbs.

Width in Inches.	THICKNESS IN FRACTIONS OF AN INCH.													Width in Inches.
	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	
1	·85	1·06	1·28	1·49	1·70	1·91	2·13	2·34	2·55	2·76	2·98	3·19	3·40	1
1⅛	·96	1·20	1·43	1·67	1·91	2·15	2·39	2·63	2·87	3·11	3·35	3·59	3·83	1⅛
1¼	1·06	1·33	1·59	1·86	2·13	2·39	2·66	2·92	3·19	3·45	3·72	3·98	4·25	1¼
1⅜	1·17	1·46	1·75	2·05	2·34	2·63	2·92	3·21	3·51	3·80	4·09	4·38	4·68	1⅜
1½	1·28	1·59	1·91	2·23	2·55	2·87	3·19	3·51	3·83	4·14	4·46	4·78	5·10	1½
1⅝	1·38	1·73	2·07	2·42	2·76	3·11	3·45	3·80	4·14	4·49	4·83	5·18	5·53	1⅝
1¾	1·49	1·86	2·23	2·60	2·98	3·35	3·72	4·09	4·46	4·83	5·21	5·58	5·95	1¾
1⅞	1·60	1·99	2·39	2·79	3·19	3·59	3·98	4·39	4·78	5·18	5·58	5·98	6·38	1⅞
2	1·70	2·13	2·55	2·98	3·40	3·83	4·25	4·68	5·10	5·53	5·95	6·38	6·80	2
2⅛	1·81	2·26	2·71	3·16	3·61	4·07	4·52	4·97	5·42	5·88	6·32	6·78	7·23	2⅛
2¼	1·91	2·39	2·87	3·35	3·83	4·30	4·78	5·26	5·74	6·22	6·69	7·17	7·65	2¼
2⅜	2·02	2·52	3·03	3·53	4·04	4·54	5·05	5·55	6·06	6·57	7·07	7·57	8·08	2⅜
2½	2·13	2·66	3·19	3·72	4·25	4·78	5·31	5·84	6·38	6·91	7·44	7·97	8·50	2½
2⅝	2·23	2·79	3·35	3·91	4·46	5·02	5·58	6·14	6·69	7·20	7·81	8·37	8·93	2⅝
2¾	2·34	2·92	3·51	4·09	4·68	5·26	5·84	6·43	7·01	7·60	8·18	8·77	9·35	2¾
2⅞	2·44	3·06	3·67	4·28	4·89	5·50	6·11	6·72	7·33	7·95	8·55	9·17	9·78	2⅞
3	2·55	3·19	3·83	4·46	5·10	5·74	6·38	7·01	7·65	8·29	8·93	9·56	10·20	3
3¼	2·76	3·45	4·14	4·83	5·53	6·22	6·91	7·60	8·29	8·98	9·67	10·36	11·05	3¼
3½	2·98	3·72	4·46	5·21	5·95	6·70	7·44	8·18	8·93	9·67	10·41	11·16	11·90	3½
3¾	3·19	3·98	4·78	5·58	6·38	7·17	7·97	8·77	9·56	10·36	11·16	11·95	12·75	3¾
4	3·40	4·25	5·10	5·95	6·80	7·65	8·50	9·35	10·20	11·05	11·90	12·75	13·60	4
4¼	3·61	4·52	5·42	6·32	7·23	8·13	9·03	9·93	10·84	11·74	12·64	13·55	14·45	4¼
4½	3·83	4·78	5·74	6·69	7·65	8·61	9·56	10·52	11·48	12·43	13·39	14·34	15·30	4½
4¾	4·04	5·05	6·06	7·07	8·08	9·08	10·09	11·10	12·11	13·12	14·13	15·14	16·15	4¾
5	4·25	5·31	6·38	7·44	8·50	9·56	10·63	11·69	12·75	13·81	14·88	15·94	17·00	5
5¼	4·46	5·58	6·69	7·81	8·93	10·04	11·16	12·27	13·39	14·50	15·62	16·73	17·85	5¼
5½	4·68	5·84	7·01	8·18	9·35	10·52	11·69	12·86	14·03	15·19	16·36	17·53	18·70	5½
5¾	4·89	6·11	7·33	8·55	9·78	11·00	12·22	13·44	14·66	15·88	17·11	18·33	19·55	5¾
6	5·10	6·38	7·65	8·93	10·20	11·48	12·75	14·03	15·30	16·58	17·85	19·13	20·40	6
6½	5·53	6·91	8·29	9·67	11·05	12·43	13·81	15·19	16·58	17·96	19·34	20·72	22·10	6½
7	5·95	7·44	8·93	10·41	11·90	13·39	14·88	16·36	17·85	19·34	20·83	22·31	23·80	7
7½	6·38	7·97	9·56	11·16	12·75	14·34	15·94	17·53	19·13	20·72	22·31	23·91	25·50	7½
8	6·80	8·50	10·20	11·90	13·60	15·30	17·00	18·70	20·40	22·10	23·80	25·50	27·20	8
8½	7·23	9·03	10·84	12·64	14·45	16·26	18·06	19·87	21·68	23·48	25·29	27·10	28·90	8½
9	7·65	9·56	11·48	13·39	15·30	17·21	19·13	21·04	22·95	24·86	26·78	28·69	30·60	9
9½	8·08	10·09	12·11	14·13	16·15	18·17	20·19	22·21	24·23	26·24	28·26	30·28	32·30	9½
10	8·50	10·63	12·75	14·88	17·00	19·13	21·25	23·38	25·50	27·63	29·75	31·88	34·00	10
10½	8·93	11·16	13·39	15·62	17·85	20·08	22·31	24·54	26·78	29·01	31·24	33·47	35·70	10½
11	9·35	11·69	14·03	16·36	18·70	21·04	23·38	25·71	28·05	30·39	32·73	35·06	37·40	11
11½	9·78	12·22	14·66	17·11	19·55	22·00	24·44	26·88	29·33	31·77	34·21	36·66	39·10	11½
12	10·20	12·75	15·30	17·85	20·40	22·95	25·50	28·05	30·60	33·15	35·70	38·25	40·80	12

Values for additional width of ¼″

¼	·213	·266	·319	·372	·425	·478	·531	·584	·638	·691	·744	·797	·850	¼

FLAT ROLLED STEEL

Weight per Lineal Foot in Lbs. (*continued*).

Width in Inches.	THICKNESS IN FRACTIONS OF AN INCH.													Width in Inches.
	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	
12½	10·62	13·28	15·94	18·59	21·25	23·90	26·56	29·22	31·88	34·54	37·20	39·84	42·50	12½
13	11·05	13·81	16·58	19·34	22·10	24·86	27·63	30·39	33·15	35·91	38·68	41·44	44·20	13
13½	11·47	14·34	17·21	20·08	22·95	25·82	28·69	31·56	34·42	37·29	40·16	43·03	45·90	13½
14	11·90	14·88	17·85	20·83	23·80	26·78	29·75	32·73	35·70	38·66	41·65	44·63	47·60	14
14½	12·32	15·41	18·49	21·57	24·65	27·73	30·81	33·90	36·97	40·05	43·13	46·22	49·30	14½
15	12·75	15·94	19·13	22·31	25·50	28·69	31·88	35·06	38·25	41·44	44·63	47·81	51·00	15
15½	13·17	16·47	19·76	23·05	26·35	29·64	32·94	36·23	39·52	42·82	46·11	49·40	52·70	15½
16	13·60	17·00	20·40	23·80	27·20	30·60	34·00	37·40	40·80	44·20	47·60	51·00	54·40	16
16½	14·02	17·53	21·04	24·54	28·05	31·55	35·06	38·57	42·07	45·58	49·09	52·59	56·10	16½
17	14·45	18·06	21·68	25·29	28·90	32·51	36·13	39·74	43·35	46·96	50·58	54·19	57·80	17
17½	14·87	18·59	22·31	26·03	29·75	33·47	37·19	40·91	44·62	48·34	52·07	55·78	59·50	17½
18	15·30	19·13	22·95	26·78	30·60	34·43	38·25	42·08	45·90	49·73	53·55	57·38	61·20	18
18½	15·72	19·66	23·59	27·52	31·45	35·39	39·31	43·24	47·17	51·11	55·04	58·97	62·90	18½
19	16·15	20·19	24·23	28·26	32·30	36·34	40·38	44·41	48·45	52·49	56·53	60·56	64·60	19
19½	16·57	20·72	24·86	29·00	33·15	37·30	41·44	45·58	49·72	53·87	58·02	62·15	66·30	19½
20	17·00	21·25	25·50	29·75	34·00	38·25	42·50	46·75	51·00	55·25	59·50	63·75	68·00	20
20½	17·42	21·78	26·14	30·49	34·85	39·21	43·56	47·92	52·27	56·63	60·99	65·34	69·70	20½
21	17·85	22·31	26·78	31·24	35·70	40·16	44·63	49·09	53·55	58·01	62·48	66·94	71·40	21
21½	18·27	22·84	27·41	31·98	36·55	41·12	45·69	50·26	54·82	59·39	63·97	68·53	73·10	21½
22	18·70	23·38	28·05	32·72	37·40	42·08	46·75	51·43	56·10	60·78	65·45	70·13	74·80	22
22½	19·12	23·91	28·69	33·46	38·25	43·04	47·81	52·59	57·37	62·16	66·94	71·72	76·50	22½
23	19·55	24·44	29·33	34·21	39·10	43·99	48·88	53·76	58·65	63·54	68·43	73·31	78·20	23
23½	19·97	24·97	29·96	34·95	39·95	44·95	49·94	54·93	59·92	64·92	69·91	74·90	79·90	23½
24	20·40	25·50	30·60	35·70	40·80	45·90	51·00	56·10	61·20	66·30	71·40	76·50	81·60	24
24½	20·82	26·03	31·24	36·44	41·65	46·86	52·06	57·27	62·47	67·68	72·89	78·09	83·30	24½
25	21·25	26·56	31·88	37·19	42·50	47·81	53·13	58·44	63·75	69·06	74·38	79·69	85·00	25
25½	21·67	27·09	32·51	37·93	43·35	48·77	54·19	59·61	65·02	70·44	75·86	81·28	86·70	25½
26	22·10	27·63	33·15	38·68	44·20	49·73	55·25	60·78	66·30	71·83	77·35	82·88	88·40	26
26½	22·52	28·16	33·79	39·42	45·05	50·69	56·31	61·94	67·57	73·21	78·84	84·47	90·10	26½
27	22·95	28·69	34·43	40·16	45·90	51·64	57·38	63·11	68·85	74·59	80·33	86·06	91·80	27
27½	23·37	29·22	35·06	40·90	46·75	52·60	58·44	64·28	70·12	75·97	81·81	87·65	93·50	27½
28	23·80	29·75	35·70	41·65	47·60	53·55	59·50	65·45	71·40	77·35	83·30	89·25	95·20	28
28½	24·22	30·28	36·34	42·39	48·45	54·51	60·56	66·62	72·67	78·73	84·79	90·84	96·90	28½
29	24·65	30·81	36·98	43·14	49·30	55·46	61·63	67·79	73·95	80·11	86·28	92·44	98·60	29
29½	25·07	31·34	37·61	43·88	50·15	56·42	62·69	68·96	75·22	81·49	87·76	94·03	100·3	29½
30	25·50	31·88	38·25	44·63	51·00	57·38	63·75	70·13	76·50	82·88	89·25	95·63	102·0	30
30½	25·92	32·41	38·89	45·37	51·85	58·34	64·81	71·30	77·77	84·26	90·74	97·22	103·7	30½
31	26·35	32·94	39·53	46·11	52·70	59·29	65·88	72·46	79·05	85·64	92·23	98·81	105·4	31
31½	26·77	33·47	40·16	46·85	53·55	60·25	66·94	73·63	80·32	87·02	93·71	100·4	107·1	31½
32	27·20	34·00	40·80	47·60	54·40	61·20	68·00	74·80	81·60	88·40	95·20	102·0	108·8	32
32½	27·62	34·53	41·44	48·34	55·25	62·16	69·06	75·97	82·87	89·78	96·69	103·6	110·5	32½
33	28·05	35·06	42·08	49·09	56·10	63·11	70·13	77·14	84·15	91·16	98·18	105·2	112·2	33
33½	28·47	35·59	42·71	49·83	56·95	64·07	71·19	78·31	85·42	92·54	99·66	106·8	113·9	33½
34	28·90	36·13	43·35	50·58	57·80	65·03	72·25	79·48	86·70	93·93	101·1	108·4	115·6	34
34½	29·32	36·66	43·99	51·32	58·65	65·99	73·31	80·65	87·97	95·31	102·6	110·0	117·3	34½
35	29·75	37·19	44·63	52·06	59·50	66·94	74·38	81·81	89·25	96·69	104·1	111·6	119·0	35
35½	30·17	37·72	45·26	52·80	60·35	67·90	75·44	82·98	90·52	98·07	105·6	113·1	120·7	35½
36	30·60	38·25	45·90	53·55	61·20	68·85	76·50	84·15	91·80	99·45	107·1	114·7	122·4	36
Values for additional width of ½″														
½	·213	·266	·319	·372	·425	·478	·531	·584	·638	·691	·744	·797	·850	½

FLAT ROLLED STEEL.

Weight per Lineal Foot in Lbs. (*concluded*).

Width in Inches.	THICKNESS IN FRACTIONS OF AN INCH.													Width in Inches.
	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	
37	31·45	39·31	47·18	55·04	62·90	70·76	78·63	86·49	94·35	102·2	110·1	117·9	125·8	37
38	32·30	40·38	48·45	56·53	64·60	72·08	80·75	88·83	96·90	105·0	113·0	121·1	129·2	38
39	33·15	41·44	49·73	58·01	66·30	74·59	82·88	91·16	99·45	107·7	116·0	124·3	132·6	39
40	34·00	42·50	51·00	59·50	68·00	76·50	85·00	93·50	102·0	110·5	119·0	127·5	136·0	40
41	34·85	43·56	52·28	60·99	69·70	78·41	87·13	95·84	104·5	113·3	122·0	130·7	139·4	41
42	35·70	44·63	53·55	62·48	71·40	80·33	89·25	98·18	107·1	116·0	124·9	133·9	142·8	42
43	36·55	45·69	54·83	63·96	73·10	82·24	91·38	100·5	109·6	118·8	127·9	137·1	146·2	43
44	37·40	46·75	56·10	65·45	74·80	84·15	93·50	102·8	112·2	121·5	130·9	140·2	149·6	44
45	38·25	47·81	57·38	66·94	76·50	86·06	95·63	105·2	114·7	124·3	133·9	143·4	153·0	45
46	39·10	48·88	58·65	68·43	78·20	87·98	97·75	107·5	117·3	127·1	136·8	146·6	156·4	46
47	39·95	49·94	59·93	69·91	79·90	89·89	99·88	109·9	119·8	129·8	139·8	149·8	159·8	47
48	40·80	51·00	61·20	71·40	81·60	91·80	102·0	112·2	122·4	132·6	142·8	153·0	163·2	48
49	41·65	52·06	62·47	72·89	83·30	93·71	104·1	114·5	124·9	135·3	145·8	156·2	166·6	49
50	42·50	53·13	63·75	74·38	85·00	95·63	106·2	116·9	127·5	138·1	148·7	159·4	170·0	50
51	43·35	54·19	65·02	75·86	86·70	97·54	108·4	119·2	139·0	140·9	151·7	162·6	173·4	51
52	44·20	55·25	66·30	77·35	88·40	99·45	110·5	121·5	132·6	143·6	154·7	165·7	176·8	52
53	45·05	56·31	67·57	78·84	90·10	101·4	112·6	123·9	135·1	146·4	157·7	168·9	180·2	53
54	45·90	57·38	68·85	80·33	91·80	103·3	114·7	126·2	137·7	149·2	160·6	172·1	183·6	54
55	46·75	58·44	70·12	81·81	93·50	105·2	116·9	128·6	140·2	151·9	163·6	175·3	187·0	55
56	47·60	59·50	71·40	83·30	95·20	107·1	119·0	130·9	142·8	154·7	166·6	178·5	190·4	56
57	48·45	60·56	72·67	84·79	96·90	109·0	121·1	133·2	145·3	157·5	169·6	181·7	193·8	57
58	49·30	61·63	73·95	86·28	98·60	110·9	123·3	135·6	147·9	160·2	172·6	184·9	197·2	58
59	50·15	62·69	75·22	87·76	100·3	112·8	125·4	137·9	150·4	163·0	175·5	188·1	200·6	59
60	51·00	63·75	76·50	89·25	102·0	114·7	127·5	140·3	153·0	165·8	178·5	191·2	204·0	60
61	51·85	64·81	77·77	90·74	103·7	116·7	129·6	142·6	155·5	168·5	181·5	194·4	207·4	61
62	52·70	65·88	79·05	92·23	105·4	118·6	131·8	144·9	158·1	171·3	184·5	197·6	210·8	62
63	53·55	66·94	80·32	93·71	107·1	120·5	133·9	147·3	160·6	174·0	187·4	200·8	214·2	63
64	54·40	68·00	81·60	95·20	108·8	122·4	136·0	149·6	163·2	176·8	190·4	204·0	217·6	64
65	55·25	69·06	82·87	96·69	110·5	124·3	138·1	151·9	165·7	179·6	193·4	207·2	221·0	65
66	56·10	70·13	84·15	98·18	112·2	126·2	140·3	154·3	168·3	182·3	196·4	210·4	224·4	66
67	56·95	71·19	85·42	99·66	113·9	128·1	142·4	156·6	170·8	185·1	199·3	213·6	227·8	67
68	57·80	72·25	86·70	101·1	115·6	130·0	144·5	159·0	173·4	187·9	202·2	216·7	231·2	68
69	58·65	73·31	87·97	102·6	117·3	132·0	146·6	161·3	175·9	190·6	205·2	219·9	234·6	69
70	59·50	74·38	89·25	104·1	119·0	133·9	148·8	163·6	178·5	193·4	208·2	223·1	238·0	70
71	60·35	75·44	90·52	105·6	120·7	135·8	150·9	166·0	181·0	196·1	211·2	226·3	241·4	71
72	61·20	76·50	91·80	107·1	122·4	137·7	153·0	168·3	183·6	198·9	214·2	229·4	244·8	72
73	62·05	77·56	93·07	108·6	124·1	139·6	155·1	170·6	186·1	201·7	217·2	232·7	248·2	73
74	62·90	78·63	94·35	110·1	125·8	141·5	157·3	173·0	188·7	204·4	220·1	235·9	251·6	74
75	63·75	79·69	95·62	111·6	127·5	143·4	159·4	175·3	191·2	207·2	223·1	239·1	255·0	75
76	64·60	80·75	96·90	113·1	129·2	145·3	161·5	177·7	193·8	210·0	226·1	242·3	258·4	76
77	65·45	81·81	98·17	114·6	130·9	147·3	163·6	180·0	196·3	212·7	229·1	245·5	261·8	77
78	66·30	82·88	99·45	116·0	132·6	149·2	165·8	182·3	198·9	215·4	232·0	248·6	265·2	78
79	67·15	83·94	100·7	117·5	134·3	151·1	167·9	184·7	201·4	218·2	235·0	251·8	268·6	79
80	68·00	85·00	102·0	119·0	136·0	153·0	170·0	187·0	204·0	221·0	238·0	255·0	272·0	80

Values for additional widths of ¼″, ½″ and ¾″

¼	·213	·266	·319	·372	·425	·478	·531	·584	·638	·691	·744	·797	·850	¼
½	·425	·531	·638	·744	·850	·956	1·063	1·169	1·275	1·381	1·488	1·594	1·700	½
¾	·638	·797	·956	1·116	1·275	1·434	1·594	1·753	1·913	2·072	2·231	2·391	2·550	¾

SQUARE AND ROUND STEEL

Weights in Lbs. per Lineal Foot and Areas in Square Inches.

Side or Diameter in inches.	Square. ■		Round. ●		Side or Diameter in inches.	Square. ■		Round. ●	
	Weight.	Area.	Weight.	Area.		Weight.	Area.	Weight.	Area.
3/16	·120	·035	·094	·027	4	54·40	16·00	42·78	12·57
¼	·213	·062	·167	·049	4¼	61·41	18·06	48·23	14·18
5/16	·332	·097	·261	·076	4½	68·85	20·25	54·07	15·90
⅜	·478	·140	·376	·110	4¾	76·71	22·56	60·25	17·72
7/16	·651	·191	·511	·150	5	85·00	25·00	66·76	19·63
½	·849	·250	·668	·196	5¼	93·71	27·56	73·60	21·65
9/16	1·076	·316	·845	·248	5½	102·85	30·25	80·78	23·76
⅝	1·328	·390	1·043	·306	5¾	112·41	33·06	88·29	25·97
11/16	1·607	·472	1·262	·371	6	122·40	36·00	96·13	28·27
¾	1·912	·562	1·502	·442	6¼	132·81	39·06	104·31	30·68
13/16	2·245	·660	1·763	·518	6½	143·65	42·25	112·82	33·18
⅞	2·603	·765	2·044	·601	6¾	154·87	45·56	121·67	35·78
15/16	2·988	·879	2·347	·690	7	166·60	49·00	130·85	38·48
1	3·400	1·000	2·670	·785	7¼	178·70	52·56	140·36	41·28
1⅛	4·303	1·265	3·380	·994	7½	191·25	56·25	150·21	44·18
1¼	5·312	1·562	4·172	1·227	7¾	201·20	60·06	160·39	47·17
1⅜	6·428	1·890	5·049	1·485	8	217·60	64·00	170·90	50·26
1½	7·650	2·250	6·008	1·767	8¼	231·40	68·06	181·75	53·45
1⅝	8·978	2·640	7·051	2·074	8½	245·65	72·25	192·93	56·74
1¾	10·41	3·062	8·178	2·405	8¾	260·30	76·56	204·45	60·13
1⅞	11·95	3·515	9·388	2·761	9	275·40	81·00	216·30	63·62
2	13·60	4·000	10·68	3·141	9¼	290·90	85·56	228·48	67·20
2⅛	15·35	4·515	12·06	3·546	9½	306·85	90·25	241·00	70·88
2¼	17·21	5·062	13·52	3·976	9¾	323·20	95·06	253·85	74·66
2⅜	19·18	5·640	15·06	4·430	10	340·00	100·00	267·04	78·54
2½	21·25	6·250	16·69	4·908	10¼	357·20	105·06	280·55	82·51
2⅝	23·43	6·890	18·40	5·412	10½	374·85	110·25	294·41	86·59
2¾	25·71	7·562	20·19	5·939	10¾	392·90	115·56	308·59	90·76
2⅞	28·10	8·265	22·07	6·492	11	411·40	121·00	323·11	95·03
3	30·60	9·000	24·03	7·068	11½	449·65	132·25	353·15	103·87
3¼	35·91	10·56	28·21	8·296	12	489·60	144·00	384·53	113·09
3½	41·65	12·25	32·71	9·621					
3¾	47·81	14·06	37·55	11·04					

MOMENTS OF INERTIA PER INCH WIDTH.

Plates at various distances apart.

Distance between plates in inches.	THICKNESS OF PLATES IN INCHES.								
	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜
8	13·16	18·08	23·29	28·78	34·57	40·67	47·07	53·80	60·86
9	16·49	22·58	28·99	35·72	42·77	50·17	57·90	65·99	74·44
10	20·19	27·58	35·32	43·41	51·85	60·67	69·86	79·43	89·39
11	24·27	33·08	42·27	51·84	61·81	72·17	82·93	94·11	105·7
12	28·72	39·08	49·85	61·03	72·63	84·67	97·14	110·1	123·4
14	38·75	52·58	66·88	81·66	96·92	112·7	128·9	145·7	163·0
15	44·33	60·08	76·33	93·09	110·4	128·2	146·5	165·4	184·8
16	50·28	68·08	86·41	105·3	124·7	144·7	165·2	186·3	208·0
18	63·32	85·58	108·4	131·9	156·0	180·7	206·0	231·9	258·5
20	77·85	105·1	133·0	161·5	190·8	220·7	251·3	282·6	314·5
24	111·4	150·1	189·5	229·8	270·8	312·7	355·3	398·8	443·1

Distance between plates in inches.	THICKNESS OF PLATES IN INCHES.								
	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½
8	68·25	75·99	84·07	92·52	101·3	110·5	120·1	130·1	140·4
9	83·25	92·44	102·0	112·0	122·3	133·1	144·3	155·9	167·9
10	99·75	110·6	121·7	133·3	145·3	157·8	170·7	184·1	197·9
11	117·7	130·2	143·1	156·5	170·3	184·6	199·4	214·7	230·4
12	137·2	151·5	166·3	181·6	197·3	213·6	230·3	247·6	265·4
14	180·7	199·1	217·9	237·4	257·3	277·9	299·0	320·6	342·9
15	204·7	225·3	246·4	268·1	290·3	313·2	336·7	360·7	385·4
16	230·2	253·1	276·6	300·6	325·3	350·6	376·6	403·2	430·4
18	285·7	313·6	342·2	371·4	401·3	431·9	463·2	495·2	527·9
20	347·2	380·7	414·8	448·7	485·3	521·7	558·8	596·7	635·4
24	488·2	534·2	581·1	628·8	677·3	726·8	777·1	828·3	880·4

The above distances between plates correspond to the depths of the British Standard Sections of Joists and Channels.

NET MAXIMUM MOMENT OF INERTIA OF STEEL JOISTS.

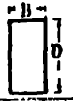
1 Rivet Hole in each Flange.

Size of Joist, - - - -	24×7½	20×7½	18×7	16×6	15×6	15×5	14×6*a*	14×6*b*
Net Moment of Inertia, -	2398	1505	1025	648·2	559·0	374·3	472·9	391·7
Size of Joist, - -	12×6*a*	12×6*b*	12×5	10×6	10×5	8×6	8×5	
Net Moment of Inertia, -	331·9	279·2	191·1	186·5	125·9	97·65	76·56	

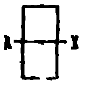
NET MAXIMUM MOMENT OF INERTIA OF STEEL CHANNELS.

1 Rivet Hole in each Flange.

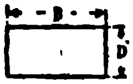
Size of Channel,- -	15×4	12×3½	10×3½	9×3½	8×3½	7×3½
Net Moment of Inertia, -	324·2	159·0	97·20	72·12	51·85	35·98



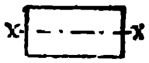
MOMENTS OF INERTIA OF RECTANGLES.



Depth in inches. D.	WIDTH OF RECTANGLE IN INCHES = B.									Depth in inches. D.
	1/16	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	
1	·005	·010	·021	·031	·042	·052	·062	·073	·083	1
2	·042	·083	·167	·250	·333	·417	·500	·583	·667	2
3	·141	·281	·562	·844	1·125	1·406	1·687	1·969	2·250	3
4	·333	·667	1·333	2·000	2·667	3·333	4·000	4·667	5·333	4
5	·651	1·302	2·604	3·906	5·208	6·510	7·812	9·115	10·42	5
6	1·125	2·250	4·500	6·750	9·000	11·25	13·50	15·75	18·00	6
7	1·786	3·573	7·146	10·72	14·29	17·86	21·44	25·01	28·58	7
8	2·667	5·333	10·67	16·00	21·33	26·67	32·00	37·33	42·67	8
9	3·797	7·594	15·19	22·78	30·37	37·97	45·56	53·16	60·75	9
10	5·208	10·42	20·83	31·25	41·67	52·08	62·50	72·92	83·33	10
11	6·932	13·86	27·73	41·59	55·46	69·32	83·19	97·05	110·9	11
12	9·000	18·00	36·00	54·00	72·00	90·00	108·0	126·0	144·0	12
13	11·44	22·89	45·77	68·66	91·54	114·4	137·3	160·2	183·1	13
14	14·29	28·58	57·17	85·75	114·3	142·9	171·5	200·1	228·7	14
15	17·58	35·16	70·31	105·5	140·6	175·8	210·9	246·1	281·2	15
16	21·33	42·67	85·33	128·0	170·7	213·3	256·0	298·7	341·3	16
17	25·59	51·18	102·4	153·5	204·7	255·9	307·1	358·2	409·4	17
18	30·37	60·75	121·5	182·2	243·0	303·7	364·5	425·2	486·0	18
19	35·72	71·45	142·9	214·3	285·8	357·2	428·7	500·1	571·6	19
20	41·67	83·33	166·7	250·0	333·3	416·7	500·0	583·3	666·7	20
21	48·23	96·47	192·9	289·4	385·9	482·3	578·8	675·3	771·7	21
22	55·46	110·9	221·8	332·7	443·7	554·6	665·5	776·4	887·3	22
23	63·37	126·7	253·5	380·2	507·0	633·7	760·4	887·2	1014	23
24	72·00	144·0	288·0	432·0	576·0	720·0	864·0	1008	1152	24
25	81·38	162·8	325·5	488·3	651·0	813·8	976·6	1139	1302	25
26	91·54	183·1	366·2	549·2	732·3	915·4	1098	1282	1465	26
27	102·5	205·0	410·1	615·1	820·1	1025	1230	1435	1640	27
28	114·3	228·7	457·3	686·0	914·7	1143	1372	1601	1829	28
29	127·0	254·1	508·1	762·2	1016	1270	1524	1778	2032	29
30	140·6	281·2	562·5	843·7	1125	1406	1687	1969	2250	30
31	155·2	310·3	620·6	931·0	1241	1552	1862	2172	2483	31
32	170·7	341·3	682·7	1024	1365	1707	2048	2389	2731	32
33	187·2	374·3	748·7	1123	1497	1872	2246	2620	2995	33
34	204·7	409·4	818·8	1228	1638	2047	2456	2866	3275	34
35	223·3	446·6	893·2	1340	1786	2233	2680	3126	3573	35
36	243·0	486·0	972·0	1458	1944	2430	2916	3402	3888	36
37	263·8	527·6	1055	1583	2111	2638	3166	3693	4221	37
38	285·8	571·6	1143	1715	2286	2858	3429	4001	4573	38
39	309·0	617·9	1236	1854	2472	3090	3707	4325	4943	39
40	333·3	666·7	1333	2000	2667	3333	4000	4667	5333	40
41	359·0	717·9	1436	2154	2872	3590	4308	5025	5743	41
42	385·9	771·7	1543	2315	3087	3859	4630	5402	6174	42



MOMENTS OF INERTIA OF RECTANGLES.

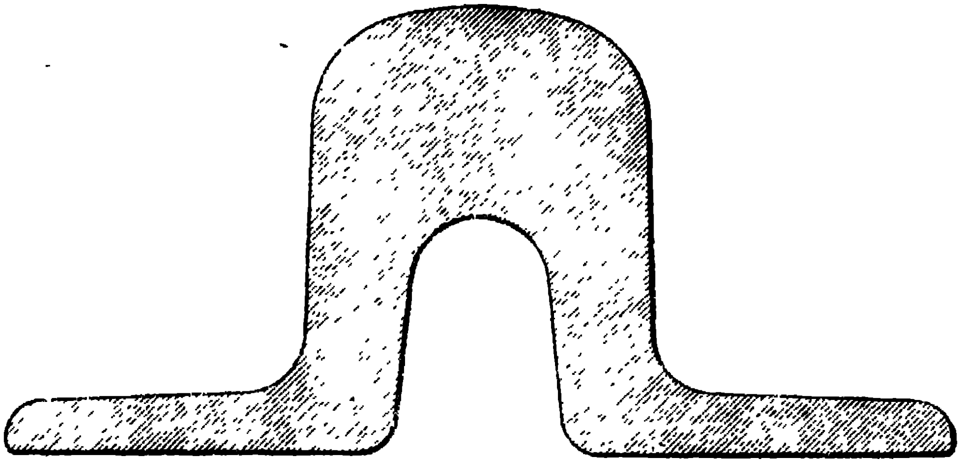


Depth in inches. D.	WIDTH OF RECTANGLE IN INCHES = B.									Depth in inches. D.
	1	2	3	4	5	6	7	8	9	
⅜	·004	·009	·013	·018	·022	·026	·031	·035	·040	⅜
½	·010	·021	·031	·042	·052	·062	·073	·083	·094	½
⅝	·020	·041	·061	·081	·102	·122	·142	·163	·183	⅝
¾	·035	·070	·105	·141	·176	·211	·246	·281	·316	¾
⅞	·056	·112	·167	·223	·279	·335	·391	·447	·502	⅞
1	·083	·167	·250	·333	·417	·500	·583	·667	·750	1
1⅛	·119	·237	·356	·475	·593	·712	·831	·949	1·068	1⅛
1¼	·163	·326	·488	·651	·814	·976	1·139	1·302	1·465	1¼
1⅜	·217	·433	·650	·867	1·083	1·300	1·517	1·733	1·950	1⅜
1½	·281	·562	·844	1·125	1·406	1·687	1·969	2·250	2·531	1½
1⅝	358	·715	1·073	1·430	1·788	2·145	2·503	2·861	3·218	1⅝
1¾	·447	·893	1·340	1·786	2·233	2·679	3·126	3·573	4·019	1¾
1⅞	·549	1·099	1·648	2·197	2·747	3·296	3·845	4·395	4·944	1⅞
2	·667	1·333	2·000	2·667	3·333	4·000	4·667	5·333	6·000	2
2⅛	·800	1·599	2·399	3·199	3·998	4·798	5·598	6·397	7·197	2⅛
2¼	·949	1·898	2·848	3·797	4·746	5·695	6·645	7·594	8·543	2¼
2⅜	1·116	2·233	3·349	4·465	5·582	6·698	7·814	8·931	10·047	2⅜
2½	1·302	2·604	3·906	5·208	6·510	7·812	9·115	10·417	11·719	2½

Depth in inches. D.	WIDTH OF RECTANGLE IN INCHES = B.									Depth in inches. D.
	10	12	14	15	16	18	20	22	24	
⅜	·044	·053	·062	·066	·070	·079	·088	·097	·105	⅜
½	·104	·125	·146	·156	·167	·187	·208	·229	·250	½
⅝	·203	·244	·285	·305	·326	·366	·407	·447	·488	⅝
¾	·352	·422	·492	·527	·562	·633	·703	·774	·844	¾
⅞	·558	·670	·782	·837	·893	1·005	1·117	1·228	1·340	⅞
1	·833	1·000	1·167	1·250	1·333	1·500	1·667	1·833	2·000	1
1⅛	1·187	1·424	1·661	1·780	1·898	2·136	2·373	2·611	2·848	1⅛
1¼	1·627	1·953	2·278	2·441	2·604	2·929	3·255	3·580	3·906	1¼
1⅜	2·167	2·600	3·033	3·250	3·466	3·900	4·333	4·767	5·199	1⅜
1½	2·812	3·375	3·937	4·219	4·500	5·062	5·625	6·187	6·750	1½
1⅝	3·576	4·291	5·006	5·364	5·721	6·436	7·152	7·867	8·582	1⅝
1¾	4·466	5·359	6·252	6·699	7·146	8·038	8·932	9·825	10·719	1¾
1⅞	5·493	6·592	7·391	8·240	8·789	9·888	10·986	12·086	13·184	1⅞
2	6·667	8·000	9·333	10·000	10·667	12·000	13·333	14·667	16·000	2
2⅛	7·997	9·596	11·195	11·995	12·794	14·394	15·993	17·593	19·191	2⅛
2¼	9·493	11·391	13·289	14·239	15·187	17·086	18·984	20·883	22·781	2¼
2⅜	11·163	13·396	15·629	16·745	17·862	20·094	22·327	24·559	26·793	2⅜
2½	13·021	15·625	18·229	19·531	20·833	23·437	26·042	28·646	31·250	2½

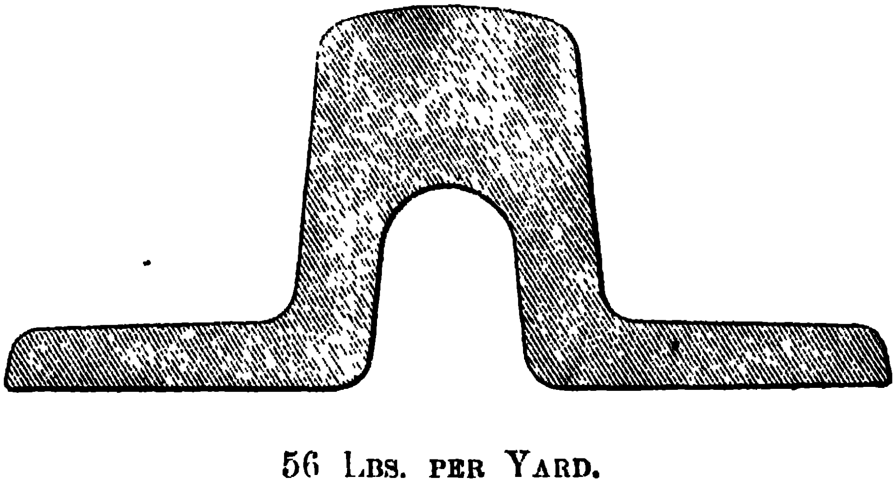
STEEL BRIDGE RAILS.

SCALE—½ FULL SIZE.



70 LBS. PER YARD.

SCALE—½ FULL SIZE.

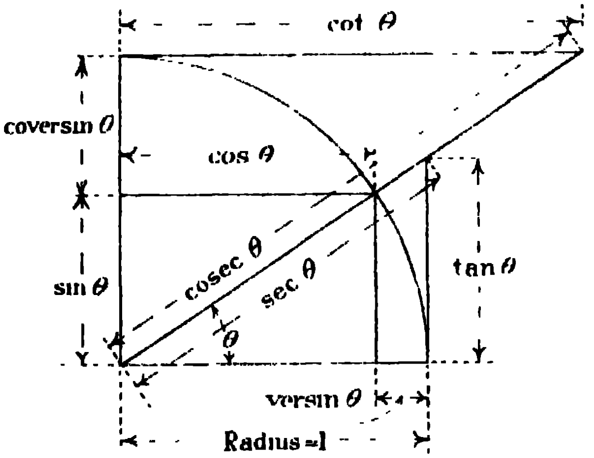


56 LBS. PER YARD.

MATHEMATICAL TABLES.

BRITISH AND METRIC
WEIGHTS AND MEASURES,
WITH
CONVERSION FACTORS AND
EQUIVALENTS.

TRIGONOMETRICAL EXPRESSIONS.



Functions of π

$$\left.\begin{array}{r}\text{Area of circle to radius } 1\\ \text{Circumf. " " " diameter } 1\end{array}\right\} = \pi$$

$$\text{Area " " " " } 1 = \frac{\pi}{4}$$

$$\text{Volume " sphere " " } 1 = \frac{\pi}{6}$$

$$\text{" " " " radius } 1 = \frac{4\pi}{3}$$

$\pi = 3{\cdot}1415926$	$\sqrt{\pi} = 1{\cdot}772454$
$\frac{\pi}{4} = 0{\cdot}785398$	$\sqrt[3]{\pi} = 1{\cdot}464590$
$\pi^2 = 9{\cdot}869604$	$\frac{\pi}{6} = 0{\cdot}523599$
$\pi^3 = 31{\cdot}006276$	$\frac{4\pi}{3} = 4{\cdot}188790$

The complement of an angle $\theta = 90^\circ - \theta$.

The supplement of an angle $\theta = 180^\circ - \theta$.

TRIGONOMETRICAL EQUIVALENTS.

$\sin\theta = \sqrt{1 - \cos^2\theta}$

$\sin\theta = 1 \div \operatorname{cosec}\theta$

$\sin\theta = \cos\theta \div \cot\theta$

$\sin\theta = \tan\theta \div \sec\theta$

$\cos\theta = \sqrt{1 - \sin^2\theta}$

$\cos\theta = 1 \div \sec\theta$

$\cos\theta = \sin\theta \times \cot\theta$

$\cos\theta = \sin\theta \div \tan\theta$

$\sec\theta = 1 \div \cos\theta$

$\sec\theta = \tan\theta \div \sin\theta$

$\operatorname{cosec}\theta = 1 \div \sin\theta$

$\tan\theta = 1 \div \cot\theta$

$\tan\theta = \sin\theta \div \cos\theta$

$\cot\theta = 1 \div \tan\theta$

$\cot\theta = \cos\theta \div \sin\theta$

$\operatorname{versin}\theta = 1 - \cos\theta$

$\operatorname{coversin}\theta = 1 - \sin\theta$

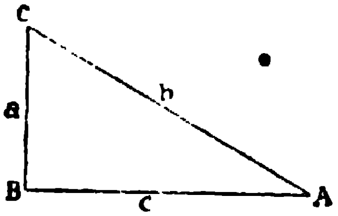
$1 = \tan\theta \times \cot\theta$

$1 = \sin^2\theta + \cos^2\theta$

$\sec^2\theta = 1 + \tan^2\theta$

TRIGONOMETRICAL FUNCTIONS.

Right-Angled Triangles.



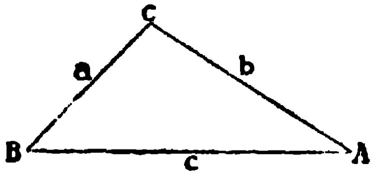
$\text{Sin A} = \frac{a}{b}$ $\text{Sec A} = \frac{b}{c}$ $\text{Tan A} = \frac{a}{c}$

$\text{Cos A} = \frac{c}{b}$ $\text{Cosec A} = \frac{b}{a}$ $\text{Cotan A} = \frac{c}{a}$

$\text{Versine A} = \frac{b-c}{b}$ $\text{Coversine A} = \frac{b-a}{b}$

Given.	Required.	Formulæ.
a, b	A, C, c	$\text{Sin A} = \frac{a}{b}$ $\text{Cos C} = \frac{a}{b}$ $c = \sqrt{(b+a)(b-a)}$
a, c	A, C, b	$\text{Tan A} = \frac{a}{c}$ $\text{Cot C} = \frac{a}{c}$ $b = \sqrt{a^2+c^2}$
A, a	C, c, b	$C = 90° - A$ $c = a \times \text{Cot A}$ $b = \frac{a}{\text{Sin A}}$
A, b	C, a, c	$C = 90° - A$ $a = b \times \text{Sin A}$ $c = b \times \text{Cos A}$
A, c	C, a, b	$C = 90° - A$ $a = c \times \text{Tan A}$ $b = \frac{c}{\text{Cos A}}$

Oblique-Angled Triangles.



Given.	Formulæ.
A,B,C,a	Areas $(a_2 \times \text{Sin B} \times \text{Sin C}) \div 2\,\text{Sin A}$
A,b,c	$\frac{1}{2}(c \times b \times \text{Sin A})$
a, b, c	$\sqrt{s\,(s-a)\,(s-b)\,(s-c)}$

Given.	Required	Formulæ.
A,C,a	c	$c = a\,\frac{\text{Sin C}}{\text{Sin A}}$
A,a,c	C	$\text{Sin C} = \frac{c\,\text{Sin A}}{a}$
a,c,B	A	$\text{Tan A} = \frac{a\,\text{Sin B}}{c - a\,\text{Cos B}}$
a, b, c	A	$\text{Sin}\,\frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{b \times c}}$; $\text{Cos}\,\frac{1}{2}A = \sqrt{\frac{s(s-a)}{b \times c}}$; $\text{Tan}\,\frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$

LOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	Mean Differences. 1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5813	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7

LOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4

ANTILOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
·00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	2	2	2
·01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2
·02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2
·03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	1	2	2	2
·04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	2	2	2	2
·05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1	2	[illegible]	2	2
·06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	2	[illegible]	2	2
·07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1	2	2	2	2
·08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	2
·09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	[illegible]	2	[illegible]
·10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	3
·11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2	2	[illegible]	2	3
·12	1318	1321	1324	1327	1330	1334	1337	1340	343	1346	0	1	1	1	2	2	2	2	3
·13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2	2	2	3	3
·14	1380	1384	1387	1390	1393	1396	1400	1403	1406	[illegible]	0	1	1	1	2	2	2	3	[illegible]
·15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	[illegible]	1	2	2	2	3	3
·16	1445	1449	1452	1455	1459	1462	1466	1469	147	1476	0	1	1	1	2	2	2	3	3
·17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2	2	2	3	3
·18	1514	1517	1521	1524	1528	1531	1535	1538	1542	154	0	1	1	1	2	2	2	3	3
·19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2	2	3	3	3
·20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2	2	3	3	3
·21	1622	1626	1629	1633	1637	1641	1644	1648	[illegible]	1656	0	1	1	2	2	2	3	3	3
·22	1660	1663	1667	1671	1675	1679	1683	1687	1090	1694	0	1	1	2	2	2	3	3	3
·23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	[illegible]	2	2	3	3	4
·24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2	2	3	3	4
·25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2	2	3	3	4
·26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2	3	3	3	4
·27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2	3	3	3	4
·28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2	3	3	4	4
·29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2	3	3	4	4
·30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
·31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
·32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
·33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
·34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
·35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
·36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
·37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
·38	2399	2404	2410	2415	2421	2427	2432	[illegible]	2443	2449	1	1	2	2	3	3	4	4	5
·39	2455	2460	2460	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	5	5
·40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
·41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
·42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
·43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
·44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
·45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	5	5	6
·46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	5	5	6
·47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	5	5	6
·48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	5	6	6
·49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	5	6	6

ANTILOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
·50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
·51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	7
·52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	7
·53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	6	6	7
·54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	6	6	7
·55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	6	7	7
·56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	6	7	8
·57	3715	372	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	6	7	8
·58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	4	4	5	6	7	8
·59	3890	900	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5	5	6	7	8
·60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5	6	6	7	8
·61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5	6	7	8	9
·62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5	6	7	8	9
·63	266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5	6	7	8	9
·64	4365	4375	4385	[illegible]	4406	4416	4426	4436	4446	4457	1	2	3	4	5	6	7	8	9
·65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5	6	7	8	9
·66	71	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5	6	7	9	10
·67	7	4688	4699	4710	4721	4732	4742	4753	4761	4775	1	2	3	4	5	7	8	9	10
·68	4786	4797	4808	4819	48	4842	4853	4864	4875	4887	1	2	3	4	6	7	8	9	10
·69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
·70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
·71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
·72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
·73	[illegible]	5383	[illegible]	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
·74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
·75	5623	5636	5649	566	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
·76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
·77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
·78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
·79	3166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
·80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
·81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
·82	6607	6022	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	12	14
·83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
·84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15
·85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
·86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
·87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
·88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
·89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
·90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
·91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
·92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
·93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
·94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
·95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
·96	9120	9141	9162	9183	9204	9226	0247	9268	9290	9311	2	4	6	8	11	13	15	17	19
·97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
·98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
·99	9772	9795	9817	9840	0863	9886	9908	9931	9954	9977	2	5	7	9	11	14	16	18	20

NATURAL SINES.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
0°	0000	0017	0035	0052	0070	0087	0105	0122	0140	0157	3	6	9	12	15
1	0175	0192	0209	0227	0244	0262	0279	0297	0314	0332	3	6	9	12	15
2	0349	0366	0384	0401	0419	0436	0454	0471	0488	0506	3	6	9	12	15
3	0523	0541	0558	0576	0593	0610	0628	0645	0663	0680	3	6	9	12	15
4	0698	0715	0732	0750	0767	0785	0802	0819	0837	0854	3	6	9	12	14
5	0872	0889	0906	0924	0941	0958	0976	0993	1011	1028	3	6	9	12	14
6	1045	1063	1080	1097	1115	1132	1149	1167	1184	1201	3	6	9	12	14
7	1219	1236	1253	1271	1288	1305	1323	1340	1357	1374	3	6	9	12	14
8	1392	1409	1426	1444	1461	1478	1495	1513	1530	1547	3	6	9	12	14
9	1564	1582	1599	1616	1633	1650	1668	1685	1702	1719	3	6	9	12	14
10	1736	1754	1771	1788	1805	1822	1840	1857	1874	1891	3	6	9	12	14
11	1908	1925	1942	1959	1977	1994	2011	2028	2045	2062	3	6	9	11	14
12	2079	2096	2113	2130	2147	2164	2181	2198	2215	2233	3	6	9	11	14
13	2250	2267	2284	2300	2317	2334	2351	2368	2385	2402	3	6	8	11	14
14	2419	2436	2453	2470	2487	2504	2521	2538	2554	2571	3	6	8	11	14
15	2588	2605	2622	2639	2656	2672	2689	2706	2723	2740	3	6	8	11	14
16	2756	2773	2790	2807	2823	2840	2857	2874	2890	2907	3	6	8	11	14
17	2924	2940	2957	2974	2990	3007	3024	3040	3057	3074	3	6	8	11	14
18	3090	3107	3123	3140	3156	3173	3190	3206	3223	3239	3	6	8	11	14
19	3256	3272	3289	3305	3322	3338	3355	3371	3387	3404	3	5	8	11	14
20	3420	3437	3453	3469	3486	3502	3518	3535	3551	3567	3	5	8	11	14
21	3584	3600	3616	3633	3649	3665	3681	3697	3714	3730	3	5	8	11	14
22	3746	3762	3778	3795	3811	3827	3843	3859	3875	3891	3	5	8	11	14
23	3907	3923	3939	3955	3971	3987	4003	4019	4035	4051	3	5	8	11	14
24	4067	4083	4099	4115	4131	4147	4163	4179	4195	4210	3	5	8	11	13
25	4226	4242	4258	4274	4289	4305	4321	4337	4352	4368	3	5	8	11	13
26	4384	4399	4415	4431	4446	4462	4478	4493	4509	4524	3	5	8	10	13
27	4540	4555	4571	4586	4602	4617	4633	4648	4664	4679	3	5	8	10	13
28	4695	4710	4726	4741	4756	4772	4787	4802	4818	4833	3	5	8	10	13
29	4848	4863	4879	4894	4909	4924	4939	4955	4970	4985	3	5	8	10	13
30	5000	5015	5030	5045	5060	5075	5090	5105	5120	5135	3	5	8	10	13
31	5150	5165	5180	5195	5210	5225	5240	5255	5270	5284	2	5	7	10	12
32	5299	5314	5329	5344	5358	5373	5388	5402	5417	5432	2	5	7	10	12
33	5446	5461	5476	5490	5505	5519	5534	5548	5563	5577	2	5	7	10	12
34	5592	5606	5621	5635	5650	5664	5678	5693	5707	5721	2	5	7	10	12
35	5736	5750	5764	5779	5793	5807	5821	5835	5850	5864	2	5	7	10	12
36	5878	5892	5906	5920	5934	5948	5962	5976	5990	6004	2	5	7	9	12
37	6018	6032	6046	6060	6074	6088	6101	6115	6129	6143	2	5	7	9	12
38	6157	6170	6184	6198	6211	6225	6239	6252	6266	6280	2	5	7	9	11
39	6293	6307	6320	6334	6347	6361	6374	6388	6401	6414	2	4	7	9	11
40	6428	6441	6455	6468	6481	6494	6508	6521	6534	6547	2	4	7	9	11
41	6561	6574	6587	6600	6613	6626	6639	6652	6665	6678	2	4	7	9	11
42	6691	6704	6717	6730	6743	6756	6769	6782	6794	6807	2	4	6	9	11
43	6820	6833	6845	6858	6871	6884	6896	6909	6921	6934	2	4	6	8	11
44	6947	6959	6972	6984	6997	7009	7022	7034	7046	7059	2	4	6	8	10

NATURAL SINES.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
45°	7071	7083	7096	7108	7120	7133	7145	7157	7169	7181	2	4	6	8	10
46	7193	7206	7218	7230	7242	7254	7266	7278	7290	7302	2	4	6	8	10
47	7314	7325	7337	7349	7361	7373	7385	7396	7408	7420	2	4	6	8	10
48	7431	7443	7455	7466	7478	7490	7501	7513	7524	7536	2	4	6	8	10
49	7547	7559	7570	7581	7593	7604	7615	7627	7638	7649	2	4	6	8	9
50	7660	7672	7683	7694	7705	7716	7727	7738	7749	7760	2	4	6	7	9
51	7771	7782	7793	7804	7815	7826	7837	7848	7859	7869	2	4	5	7	9
52	7880	7891	7902	7912	7923	7934	7944	7955	7965	7976	2	4	5	7	9
53	7986	7997	8007	8018	8028	8039	8049	8059	8070	8080	2	3	5	7	9
54	8090	8100	8111	8121	8131	8141	8151	8161	8171	8181	2	3	5	7	8
55	8192	8202	8211	8221	8231	8241	8251	8261	8271	8281	2	3	5	7	8
56	8290	8300	8310	8320	8329	8339	8348	8358	8368	8377	2	3	5	6	8
57	8387	8396	8406	8415	8425	8434	8443	8453	8462	8471	2	3	5	6	8
58	8480	8490	8499	8508	8517	8526	8536	8545	8554	8563	2	3	5	6	8
59	8572	8581	8590	8599	8607	8616	8625	8634	8643	8652	1	3	4	6	7
60	8660	8669	8678	8686	8695	8704	8712	8721	8729	8738	1	3	4	6	7
61	8746	8755	8763	8771	8780	8788	8796	8805	8813	8821	1	3	4	6	7
62	8829	8838	8846	8854	8862	8870	8878	8886	8894	8902	1	3	4	5	7
63	8910	8918	8926	8934	8942	8949	8957	8965	8973	8980	1	3	4	5	6
64	8988	8996	9003	9011	9018	9026	9033	9041	9048	9056	1	3	4	5	6
65	9063	9070	9078	9085	9092	9100	9107	9114	9121	9128	1	2	4	5	6
66	9135	9143	9150	9157	9164	9171	9178	9184	9191	9198	1	2	3	5	6
67	9205	9212	9219	9225	9232	9239	9245	9252	9259	9265	1	2	3	4	6
68	9272	9278	9285	9291	9298	9304	9311	9317	9323	9330	1	2	3	4	5
69	9336	9342	9348	9354	9361	9367	9373	9379	9385	9391	1	2	3	4	5
70	9397	9403	9409	9415	9421	9426	9432	9438	9444	9449	1	2	3	4	5
71	9455	9461	9466	9472	9478	9483	9489	9494	9500	9505	1	2	3	4	5
72	9511	9516	9521	9527	9532	9537	9542	9548	9553	9558	1	2	3	4	4
73	9563	9568	9573	9578	9583	9588	9593	9598	9603	9608	1	2	2	3	4
74	9613	9617	9622	9627	9632	9636	9641	9646	9650	9655	1	2	2	3	4
75	9659	9664	9668	9673	9677	9681	9686	9690	9694	9699	1	1	2	3	4
76	9703	9707	9711	9715	9720	9724	9728	9732	9736	9740	1	1	2	3	3
77	9744	9748	9751	9755	9759	9763	9767	9770	9774	9778	1	1	2	3	3
78	9781	9785	9789	9792	9796	9799	9803	9806	9810	9813	1	1	2	2	3
79	9816	9820	9823	9826	9829	9833	9836	9839	9842	9845	1	1	2	2	3
80	9848	9851	9854	9857	9860	9863	9866	9869	9871	9874	0	1	1	2	2
81	9877	9880	9882	9885	9888	9890	9893	9895	9898	9900	0	1	1	2	2
82	9903	9905	9907	9910	9912	9914	9917	9919	9921	9923	0	1	1	2	2
83	9925	9928	9930	9932	9934	9936	9938	9940	9942	9943	0	1	1	1	2
84	9945	9947	9949	9951	9952	9954	9956	9957	9959	9960	0	1	1	1	1
85	9962	9963	9965	9966	9968	9969	9971	9972	9973	9974	0	0	1	1	1
86	9976	9977	9978	9979	9980	9981	9982	9983	9984	9985	0	0	1	1	1
87	9986	9987	9988	9989	9990	9990	9991	9992	9993	9993	0	0	0	1	1
88	9994	9995	9995	9996	9996	9997	9997	9997	9998	9998	0	0	0	0	0
89	9998	9999	9999	9999	9999	1·000	1·000	1·000	1·000	1·000	0	0	0	0	0

NATURAL COSINES.

N.B.—Subtract Mean Differences.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
0°	1·000	1·000	1·000	1·000	1·000	1·000	9999	9999	9990	9099	0	0	0	0	0
1	9998	9998	9998	9997	9997	9997	9996	9996	9995	9995	0	0	0	0	0
2	9994	9993	9993	9992	9991	9990	9990	9989	9988	9987	0	0	0	1	1
3	9986	9985	9984	9983	9982	9981	9980	9979	9978	9977	0	0	1	1	1
4	9976	9974	9973	9972	9971	9969	9968	9966	9965	9963	0	0	1	1	1
5	9902	9960	9959	9957	9956	9954	9952	9951	9949	9947	0	1	1	1	2
6	9945	9943	9942	9940	9938	9936	9934	9932	9930	9928	0	1	1	1	2
7	9925	9923	9921	9919	9917	9914	9912	9910	9907	9905	0	1	1	2	2
8	9903	9900	9898	9895	9893	9890	9888	9885	9882	9880	0	1	1	2	2
9	9877	9874	9871	9869	9866	9863	9860	9857	9854	9851	0	1	1	2	2
10	9848	9845	9842	9839	9836	9833	9829	9826	9823	9820	1	1	2	2	3
11	9816	9813	9810	9806	9803	9799	9796	9792	9789	9785	1	1	2	2	3
12	9781	9778	9774	9770	9767	9763	9759	9755	9751	9748	1	1	2	3	3
13	9744	9740	9736	9732	9728	9724	9720	9715	9711	9707	1	1	2	3	3
14	9703	9699	9694	9690	9686	9681	9677	9673	9668	9664	1	1	2	3	4
15	9659	9655	9650	9646	9641	9636	9632	9627	9622	9617	1	2	2	3	4
16	9613	9608	9603	9598	9593	9588	9583	9578	9573	9568	1	2	2	3	4
17	9563	9558	9553	9548	9542	9537	9532	9527	9521	9516	1	2	3	4	4
18	9511	9505	9500	9494	9489	9483	9478	9472	9466	9461	1	2	3	4	5
19	9455	9449	9444	9438	9432	9426	9421	9415	9409	9403	1	2	3	4	5
20	9397	9391	9385	9379	9373	9367	9361	9354	9348	9342	1	2	3	4	5
21	9336	9330	9323	9317	9311	9304	9298	9291	9285	9278	1	2	3	4	5
22	9272	9265	9259	9252	9245	9239	9232	9225	9219	9212	1	2	3	4	6
23	9205	9198	9191	9184	9178	9171	9164	9157	9150	9143	1	2	3	5	6
24	9135	9128	9121	9114	9107	9100	9092	9085	9078	9070	1	2	4	5	6
25	9063	9056	9048	9041	9033	9026	9018	9011	9003	8996	1	3	4	5	6
26	8988	8980	8973	8965	8957	8949	8942	8934	8926	8918	1	3	4	5	6
27	8910	8902	8894	8886	8878	8870	8862	8854	8846	8838	1	3	4	5	7
28	8829	8821	8813	8805	8796	8788	8780	8771	8763	8755	1	3	4	6	7
29	8746	8738	8729	8721	8712	8704	8695	8686	8678	8669	1	3	4	6	7
30	8660	8652	8643	8634	8625	8616	8607	8599	8590	8581	1	3	4	6	7
31	8572	8563	8554	8545	8536	8526	8517	8508	8499	8490	2	3	5	6	8
32	8480	8471	8462	8453	8443	8434	8425	8415	8406	8396	2	3	5	6	8
33	8387	8377	8368	8358	8348	8339	8329	8320	8310	8300	2	3	5	6	8
34	8290	8281	8271	8261	8251	8241	8231	8221	8211	8202	2	3	5	7	8
35	8192	8181	8171	8161	8151	8141	8131	8121	8111	8100	2	3	5	7	8
36	8090	8080	8070	8059	8049	8039	8028	8018	8007	7997	2	3	5	7	9
37	7986	7976	7965	7955	7944	7934	7923	7912	7902	7891	2	4	5	7	9
38	7880	7869	7859	7848	7837	7826	7815	7804	7793	7782	2	4	5	7	9
39	7771	7760	7749	7738	7727	7716	7705	7694	7683	7672	2	4	6	7	9
40	7660	7649	7638	7627	7615	7604	7593	7581	7570	7559	2	4	6	8	9
41	7547	7536	7524	7513	7501	7490	7478	7466	7455	7443	2	4	6	8	10
42	7431	7420	7408	7396	7385	7373	7361	7349	7337	7325	2	4	6	8	10
43	7314	7302	7290	7278	7266	7254	7242	7230	7218	7206	2	4	6	8	10
44	7193	7181	7169	7157	7145	7133	7120	7108	7096	7083	2	4	6	8	10

NATURAL COSINES.

N.B.—**Subtract Mean Differences.**

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
45°	7071	7059	7046	7034	7022	7009	6997	6984	6972	6959	2	4	6	8	10
46	6947	6934	6921	6909	6896	6884	6871	6858	6845	6833	2	4	6	8	11
47	6820	6807	6794	6782	6769	6756	6743	6730	6717	6704	2	4	6	9	11
48	6691	6678	6665	6652	6639	6626	6613	6600	6587	6574	2	4	7	9	11
49	6561	6547	6534	6521	6508	6494	6481	6468	6455	6441	2	4	7	9	11
50	6428	6414	6401	6388	6374	6361	6347	6334	6320	6307	2	4	7	9	11
51	6293	6280	6266	6252	6239	6225	6211	6198	6184	6170	2	5	7	9	11
52	6157	6143	6129	6115	6101	6088	6074	6060	6046	6032	2	5	7	9	12
53	6018	6004	5990	5976	5962	5948	5934	5920	5906	5892	2	5	7	9	12
54	5878	5864	5850	5835	5821	5807	5793	5779	5764	5750	2	5	7	9	12
55	5736	5721	5707	5693	5678	5664	5650	5635	5621	5606	2	5	7	10	12
56	5592	5577	5563	5548	5534	5519	5505	5490	5476	5461	2	5	7	10	12
57	5446	5432	5417	5402	5388	5373	5358	5344	5329	5314	2	5	7	10	12
58	5299	5284	5270	5255	5240	5225	5210	5195	5180	5165	2	5	7	10	12
59	5150	5135	5120	5105	5090	5075	5060	5045	5030	5015	3	5	8	10	13
60	5000	4985	4970	4955	4939	4924	4909	4894	4879	4863	3	5	8	10	13
61	4848	4833	4818	4802	4787	4772	4756	4741	4726	4710	3	5	8	10	13
62	4695	4679	4664	4648	4633	4617	4602	4586	4571	4555	3	5	8	10	13
63	4540	4524	4509	4493	4478	4462	4446	4431	4415	4399	3	5	8	10	13
64	4384	4368	4352	4337	4321	4305	4289	4274	4258	4242	3	5	8	11	13
65	4226	4210	4195	4179	4163	4147	4131	4115	4099	4083	3	5	8	11	13
66	4067	4051	4035	4019	4003	3987	3971	3955	3939	3923	3	5	8	11	14
67	3907	3891	3875	3859	3843	3827	3811	3795	3778	3762	3	5	8	11	14
68	3746	3730	3714	3697	3681	3665	3649	3633	3616	3600	3	5	8	11	14
69	3584	3567	3551	3535	3518	3502	3486	3469	3453	3437	3	5	8	11	14
70	3420	3404	3387	3371	3355	3338	3322	3305	3289	3272	3	5	8	11	14
71	3256	3239	3223	3206	3190	3173	3156	3140	3123	3107	3	6	8	11	14
72	3090	3074	3057	3040	3024	3007	2990	2974	2957	2940	3	6	8	11	14
73	2924	2907	2890	2874	2857	2840	2823	2807	2790	2773	3	6	8	11	14
74	2756	2740	2723	2706	2689	2672	2656	2639	2622	2605	3	6	8	11	14
75	2588	2571	2554	2538	2521	2504	2487	2470	2453	2436	3	6	8	11	14
76	2419	2402	2385	2368	2351	2334	2317	2300	2284	2267	3	6	8	11	14
77	2250	2233	2215	2198	2181	2164	2147	2130	2113	2096	3	6	9	11	14
78	2079	2062	2045	2028	2011	1994	1977	1959	1942	1925	3	6	9	11	14
79	1908	1891	1874	1857	1840	1822	1805	1788	1771	1754	3	6	9	12	14
80	1736	1719	1702	1685	1668	1650	1633	1616	1599	1582	3	6	9	12	14
81	1564	1547	1530	1513	1495	1478	1461	1444	1426	1409	3	6	9	12	14
82	1392	1374	1357	1340	1323	1305	1288	1271	1253	1236	3	6	9	12	14
83	1219	1201	1184	1167	1149	1132	1115	1097	1080	1063	3	6	9	12	14
84	1045	1028	1011	0993	0976	0958	0941	0924	0906	0889	3	6	9	12	14
85	0872	0854	0837	0819	0802	0785	0767	0750	0732	0715	3	6	9	12	14
86	0698	0680	0663	0645	0628	0610	0593	0576	0558	0541	3	6	9	12	15
87	0523	0506	0488	0471	0454	0436	0419	0401	0384	0366	3	6	9	12	15
88	0349	0332	0314	0297	0279	0262	0244	0227	0209	0192	3	6	9	12	15
89	0175	0157	0140	0122	0105	0087	0070	0052	0035	0017	3	6	9	12	15

NATURAL TANGENTS.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
0°	·0000	0017	0035	0052	0070	0087	0105	0122	0140	0157	3	6	9	12	15
1	·0175	0192	0209	0227	0244	0262	0279	0297	0314	0332	3	6	9	12	15
2	·0349	0367	0384	0402	0419	0437	0454	0472	0489	0507	3	6	9	12	15
3	·0524	0542	0559	0577	0594	0612	0629	0647	0664	0682	3	6	9	12	15
4	·0699	0717	0734	0752	0769	0787	0805	0822	0840	0857	3	6	9	12	15
5	·0875	0892	0910	0928	0945	0963	0981	0998	1016	1033	3	6	9	12	15
6	·1051	1069	1086	1104	1122	1139	1157	1175	1192	1210	3	6	9	12	15
7	·1228	1246	1263	1281	1299	1317	1334	1352	1370	1388	3	6	9	12	15
8	·1405	1423	1441	1459	1477	1495	1512	1530	1548	1566	3	6	9	12	15
9	·1584	1602	1620	1638	1655	1673	1691	1709	1727	1745	3	6	9	12	15
10	·1763	1781	1799	1817	1835	1853	1871	1890	1908	1926	3	6	9	12	15
11	·1944	1962	1980	1998	2016	2035	2053	2071	2089	2107	3	6	9	12	15
12	·2126	2144	2162	2180	2199	2217	2235	2254	2272	2290	3	6	9	12	15
13	·2309	2327	2345	2364	2382	2401	2419	2438	2456	2475	3	6	9	12	15
14	·2493	2512	2530	2549	2568	2586	2605	2623	2642	2661	3	6	9	12	16
15	·2679	2698	2717	2736	2754	2773	2792	2811	2830	2849	3	6	9	13	16
16	·2867	2886	2905	2924	2943	2962	2981	3000	3019	3038	3	6	9	13	16
17	·3057	3076	3096	3115	3134	3153	3172	3191	3211	3230	3	6	10	13	16
18	·3249	3269	3288	3307	3327	3346	3365	3385	3404	3424	3	6	10	13	16
19	·3443	3463	3482	3502	3522	3541	3561	3581	3600	3620	3	7	10	13	16
20	·3640	3659	3679	3699	3719	3739	3759	3779	3799	3819	3	7	10	13	17
21	·3839	3859	3879	3899	3919	3939	3959	3979	4000	4020	3	7	10	13	17
22	·4040	4061	4081	4101	4122	4142	4163	4183	4204	4224	3	7	10	14	17
23	·4245	4265	4286	4307	4327	4348	4369	4390	4411	4431	3	7	10	14	17
24	·4452	4473	4494	4515	4536	4557	4578	4599	4621	4642	4	7	11	14	18
25	·4663	4684	4706	4727	4748	4770	4791	4813	4834	4856	4	7	11	14	18
26	·4877	4899	4921	4942	4964	4986	5008	5029	5051	5073	4	7	11	15	18
27	·5095	5117	5139	5161	5184	5206	5228	5250	5272	5295	4	7	11	15	18
28	·5317	5340	5362	5384	5407	5430	5452	5475	5498	5520	4	8	11	15	19
29	·5543	5566	5589	5612	5635	5658	5681	5704	5727	5750	4	8	12	15	19
30	·5774	5797	5820	5844	5867	5890	5914	5938	5961	5985	4	8	12	16	20
31	·6009	6032	6056	6080	6104	6128	6152	6176	6200	6224	4	8	12	16	20
32	·6249	6273	6297	6322	6346	6371	6395	6420	6445	6469	4	8	12	16	20
33	·6494	6519	6544	6569	6594	6619	6644	6669	6694	6720	4	8	13	17	21
34	·6745	6771	6796	6822	6847	6873	6899	6924	6950	6976	4	9	13	17	21
35	·7002	7028	7054	7080	7107	7133	7159	7186	7212	7239	4	9	13	18	22
36	·7265	7292	7319	7346	7373	7400	7427	7454	7481	7508	5	9	14	18	23
37	·7536	7563	7590	7618	7646	7673	7701	7729	7757	7785	5	9	14	18	23
38	·7813	7841	7869	7898	7926	7954	7983	8012	8040	8069	5	9	14	19	24
39	·8098	8127	8156	8185	8214	8243	8273	8302	8332	8361	5	10	15	20	24
40	·8391	8421	8451	8481	8511	8541	8571	8601	8632	8662	5	10	15	20	25
41	·8693	8724	8754	8785	8816	8847	8878	8910	8941	8972	5	10	16	21	26
42	·9004	9036	9067	9099	9131	9163	9195	9228	9260	9293	5	11	16	21	27
43	·9325	9358	9391	9424	9457	9490	9523	9556	9590	9623	6	11	17	22	28
44	·9657	9691	9725	9759	9793	9827	9861	9896	9930	9965	6	11	17	23	29

NATURAL TANGENTS.

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	Mean Differences.				
											1'	2'	3'	4'	5'
45°	1·0000	0035	0070	0105	0141	0176	0212	0247	0283	0319	6	12	18	24	30
46	1·0355	0392	0428	0464	0501	0538	0575	0612	0649	0686	6	12	18	25	31
47	1·0724	0761	0799	0837	0875	0913	0951	0900	1028	1067	6	13	19	25	32
48	1·1106	1145	1184	1224	1263	1303	1343	1383	1423	1463	7	13	20	27	33
49	1·1504	1544	1585	1626	1667	1708	1750	1792	1833	1875	7	14	21	28	34
50	1·1918	1960	2002	2045	2088	2131	2174	2218	2261	2305	7	14	22	29	36
51	1·2349	2393	2437	2482	2527	2572	2617	2662	2708	2753	8	15	23	30	38
52	1·2799	2846	2892	2938	2985	3032	3079	3127	3175	3222	8	16	24	31	39
53	1·3270	3319	3367	3416	3465	3514	3564	3613	3663	3713	8	16	25	33	41
54	1·3764	3814	3865	3916	3968	4019	4071	4124	4176	4229	9	17	26	34	43
55	1·4281	4335	4388	4442	4496	4550	4605	4659	4715	4770	9	18	27	36	45
56	1·4826	4882	4938	4994	5051	5108	5166	5224	5282	5340	10	19	29	38	48
57	1·5399	5458	5517	5577	5637	5697	5757	5818	5880	5941	10	20	30	40	50
58	1·6003	6066	6128	6191	6255	6319	6383	6447	6512	6577	11	21	32	43	53
59	1·6643	6709	6775	6842	6909	6977	7045	7113	7182	7251	11	23	34	45	56
60	1·7321	7391	7461	7532	7603	7675	7747	7820	7893	7966	12	24	36	48	60
61	1·8040	8115	8190	8265	8341	8418	8495	8572	8650	8728	13	26	38	51	64
62	1·8807	8887	8967	9047	9128	9210	9292	9375	9458	9542	14	27	41	55	68
63	1·9626	9711	9797	9883	9970	*0057*	*0145*	*0233*	*0323*	*0413*	15	29	44	58	73
64	2·0503	0594	0686	0778	0872	0965	1060	1155	1251	1348	16	31	47	63	78
65	2·1445	1543	1642	1742	1842	1943	2045	2148	2251	2355	17	34	51	68	85
66	2·2460	2566	2673	2781	2889	2998	3109	3220	3332	3445	18	37	55	73	92
67	2·3559	3673	3789	3906	4023	4142	4262	4383	4504	4627	20	40	60	79	99
68	2·4751	4876	5002	5129	5257	5386	5517	5649	5782	5916	22	43	65	87	108
69	2·6051	6187	6325	6464	6605	6746	6889	7034	7179	7326	24	47	71	95	119
70	2·7475	7625	7776	7929	8083	8239	8397	8556	8716	8878	26	52	78	104	131
71	2·9042	9208	9375	9544	9714	9887	*0061*	*0237*	*0415*	*0595*	29	58	87	116	145
72	3·0777	0961	1146	1334	1524	1716	1910	2106	2305	2506	32	64	96	129	161
73	3·2709	2914	3122	3332	3544	3759	3977	4197	4420	4646	36	72	108	144	180
74	3·4874	5105	5339	5576	5816	6059	6305	6554	6806	7062	41	81	122	163	204
75	3·7321	7583	7848	8118	8391	8667	8947	9232	9520	9812					
76	4·0108	0408	0713	1022	1335	1653	1976	2303	2635	2972					
77	4·3315	3662	4015	4374	4737	5107	5483	5864	6252	6646					
78	4·7046	7453	7867	8288	8716	9152	9594	*0045*	*0504*	*0970*					
79	5·1446	1929	2422	2924	3435	3955	4486	5026	5578	6140					
80	5·6713	7297	7894	8502	9124	9758	*0405*	*1066*	*1742*	*2432*	Owing to the rapidity with which the tangent changes, mean differences cease to be useful.				
81	6·3138	3859	4596	5350	6122	6912	7720	8548	9395	*0264*					
82	7·1154	2066	3002	3962	4947	5958	6996	8062	9158	*0285*					
83	8·1443	2636	3863	5126	6427	7769	9152	*0579*	*2052*	*3572*					
84	9·514	9·677	9·845	10·02	10·20	10·39	10·58	10·78	10·99	11·20					
85	11·43	11·66	11·91	12·16	12·43	12·71	13·00	13·30	13·62	13·95					
86	14·30	14·67	15·06	15·46	15·89	16·35	16·83	17·34	17·89	18·46					
87	19·08	19·74	20·45	21·20	22·02	22·90	23·86	24·90	26·03	27·27					
88	28·64	30·14	31·82	33·69	35·80	38·19	40·92	44·07	47·74	52·08					
89	57·29	63·66	71·62	81·85	95·49	114·6	143·2	191·0	286·5	573·0					

NATURAL COSECANTS.

***N.B.*—Subtract Mean Differences.**

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
0°	Inf.	573·0	286·5	191·0	143·2	114·6	95·49	81·85	71·62	63·66	**Owing to the rapidity with which cosecant changes, mean differences are of no use.**				
1	57·30	52·09	47·75	44·08	40·93	38·20	35·81	33·71	31·84	30·16					
2	28·65	27·29	26·05	24·92	23·88	22·93	22·04	21·23	20·47	19·77					
3	19·11	18·49	17·91	17·37	16·86	16·38	15·93	15·50	15·09	14·70					
4	14·34	13·99	13·65	13·34	13·03	12·75	12·47	12·20	11·95	11·71					
5	11·47	11·25	11·03	10·83	10·63	10·43	10·25	10·07	9·895	9·728					
6	9·5668	4105	2593	1129	*9711*	*8337*	*7004*	*5711*	*4457*	*3238*					
7	8·2055	0905	*9787*	*8700*	*7642*	*6613*	*5611*	*4635*	*3684*	*2757*					
8	7·1853	0972	0112	*9273*	*8454*	*7655*	*6874*	*6111*	*5366*	*4637*					
9	6·3925	3228	2546	1880	1227	0589	*9963*	*9351*	*8751*	*8164*					
10	5·7588	7023	6470	5928	5396	4874	4362	3860	3367	2883					
11	5·2408	1942	1484	1034	0593	0159	*9732*	*9313*	*8901*	*8496*					
12	4·8097	7706	7321	6942	6569	6202	5841	5486	5137	4793	61	122	182	243	304
13	4·4454	4121	3792	3469	3150	2837	2527	2223	1923	1627	52	104	156	208	260
14	4·1336	1048	0765	0486	0211	*9939*	*9672*	*9408*	*9147*	*8890*	45	90	135	180	225
15	3·8637	8387	8140	7897	7657	7420	7186	6955	6727	6502	39	79	118	157	196
16	3·6280	6060	5843	5629	5418	5209	5003	4799	4598	4399	35	69	104	138	173
17	3·4203	4009	3817	3628	3440	3255	3072	2891	2712	2535	31	61	92	123	154
18	3·2361	2188	2017	1848	1681	1515	1352	1190	1030	0872	27	55	82	110	137
19	3·0716	0561	0407	0256	0106	*9957*	*9811*	*9665*	*9521*	*9379*	25	49	74	99	123
20	2·9238	9099	8960	8824	8688	8555	8422	8291	8161	8032	22	44	67	89	111
21	2·7904	7778	7653	7529	7407	7285	7165	7046	6927	6811	20	40	60	81	101
22	2·6695	6580	6466	6354	6242	6131	6022	5913	5805	5699	18	37	55	73	92
23	2·5593	5488	5384	5282	5180	5078	4978	4879	4780	4083	17	34	50	67	84
24	2·4586	4490	4395	4300	4207	4114	4022	3931	3841	3751	15	31	46	62	77
25	2·3662	3574	3486	3400	3314	3228	3144	3060	2976	2894	14	28	43	57	71
26	2·2812	2730	2650	2570	2490	2412	2333	2256	2179	2103	13	26	39	52	65
27	2·2027	1952	1877	1803	1730	1657	1584	1513	1441	1371	12	24	36	48	60
28	2·1301	1231	1162	1093	1025	0957	0890	0824	0757	0692	11	22	34	45	56
29	2·0627	0562	0498	0434	0371	0308	0245	0183	0122	0061	10	21	31	42	52
30	2·0000	*9940*	*9880*	*9821*	*9762*	*9703*	*9645*	*9587*	*9530*	*9473*	10	19	29	39	49
31	1·9416	9360	9304	9249	9194	9139	9084	9031	8977	8924	9	18	27	36	45
32	1·8871	8818	8766	8714	8663	8612	8561	8510	8460	8410	8	17	25	34	42
33	1·8361	8312	8263	8214	8166	8118	8070	8023	7976	7929	8	16	24	32	40
34	1·7883	7837	7791	7745	7700	7655	7610	7566	7522	7478	7	15	22	30	37
35	1·7434	7391	7348	7305	7263	7221	7179	7137	7095	7054	7	14	21	28	35
36	1·7013	6972	6932	6892	6852	6812	6772	6733	6694	6655	7	13	20	26	33
37	1·6616	6578	6540	6502	6464	6427	6390	6353	6316	6279	6	12	19	25	31
38	1·6243	6207	6171	6135	6099	6064	6029	5994	5959	5925	6	12	18	23	29
39	1·5890	5856	5822	5788	5755	5721	5688	5655	5622	5590	6	11	17	22	28
40	1·5557	5525	5493	5461	5429	5398	5366	5335	5304	5273	5	10	16	21	26
41	1·5243	5212	5182	5151	5121	5092	5062	5032	5003	4974	5	10	15	20	25
42	1·4945	4916	4887	4859	4830	4802	4774	4746	4718	4690	5	9	14	19	23
43	1·4663	4635	4608	4581	4554	4527	4501	4474	4448	4422	4	9	13	18	22
44	1·4396	4370	4344	4318	4293	4267	4242	4217	4192	4167	4	8	13	17	21

NATURAL COSECANTS.

N.B.—Subtract Mean Differences.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
45°	1·4142	4118	4093	4069	4044	4020	3996	3972	3949	3925	4	8	12	16	20
46	1·3902	3878	3855	3832	3809	3786	3763	3741	3718	3696	4	8	11	15	19
47	1·3673	3651	3629	3607	3585	3563	3542	3520	3499	3478	4	7	11	14	18
48	1·3456	3435	3414	3393	3373	3352	3331	3311	3291	3270	3	7	10	14	17
49	1·3250	3230	3210	3190	3171	3151	3131	3112	3093	3073	3	7	10	13	16
50	1·3054	3035	3016	2997	2978	2960	2941	2923	2904	2886	3	6	9	12	15
51	1·2868	2849	2831	2813	2796	2778	2760	2742	2725	2708	3	6	9	12	15
52	1·2690	2673	2656	2639	2622	2605	2588	2571	2554	2538	3	6	8	11	14
53	1·2521	2505	2489	2472	2456	2440	2424	2408	2392	2376	3	5	8	11	13
54	1·2361	2345	2329	2314	2299	2283	2268	2253	2238	2223	3	5	8	10	13
55	1·2208	2193	2178	2163	2149	2134	2120	2105	2091	2076	2	5	7	10	12
56	1·2062	2048	2034	2020	2006	1992	1978	1964	1951	1937	2	5	7	9	12
57	1·1924	1910	1897	1883	1870	1857	1844	1831	1818	1805	2	4	7	9	11
58	1·1792	1779	1766	1753	1741	1728	1716	1703	1691	1679	2	4	6	8	10
59	1·1666	1654	1642	1630	1618	1606	1594	1582	1570	1559	2	4	6	8	10
60	1·1547	1535	1524	1512	1501	1490	1478	1467	1456	1445	2	4	6	8	9
61	1·1434	1423	1412	1401	1390	1379	1368	1357	1347	1336	2	4	5	7	9
62	1·1326	1315	1305	1294	1284	1274	1264	1253	1243	1233	2	3	5	7	9
63	1·1223	1213	1203	1194	1184	1174	1164	1155	1145	1136	2	3	5	6	8
64	1·1126	1117	1107	1098	1089	1079	1070	1061	1052	1043	2	3	5	6	8
65	1·1034	1025	1016	1007	0998	0989	0981	0972	0963	0955	1	3	4	6	7
66	1·0946	0938	0929	0921	0913	0904	0896	0888	0880	0872	1	3	4	6	7
67	1·0864	0856	0848	0840	0832	0824	0816	0808	0801	0793	1	3	4	5	7
68	1·0785	0778	0770	0763	0755	0748	0740	0733	0726	0719	1	2	4	5	6
69	1·0711	0704	0697	0690	0683	0676	0669	0662	0655	0649	1	2	3	5	6
70	1·0642	0635	0628	0622	0615	0608	0602	0595	0589	0583	1	2	3	4	5
71	1·0576	0570	0564	0557	0551	0545	0539	0533	0527	0521	1	2	3	4	5
72	1·0515	0509	0503	0497	0491	0485	0480	0474	0468	0463	1	2	3	4	5
73	1·0457	0451	0446	0440	0435	0429	0424	0419	0413	0408	1	2	3	4	4
74	1·0403	0398	0393	0388	0382	0377	0372	0367	0363	0358	1	2	2	3	4
75	1·0353	0348	0343	0338	0334	0329	0324	0320	0315	0311	1	2	2	3	4
76	1·0306	0302	0297	0293	0288	0284	0280	0276	0271	0267	1	1	2	3	4
77	1·0263	0259	0255	0251	0247	0243	0239	0235	0231	0227	1	1	2	3	3
78	1·0223	0220	0216	0212	0209	0205	0201	0198	0194	0191	1	1	2	3	3
79	1·0187	0184	0180	0177	0174	0170	0167	0164	0161	0157	1	1	2	2	3
80	1·0154	0151	0148	0145	0142	0139	0136	0133	0130	0127	0	1	1	2	2
81	1·0125	0122	0119	0116	0114	0111	0108	0106	0103	0101	0	1	1	2	2
82	1·0098	0096	0093	0091	0089	0086	0084	0082	0079	0077	0	1	1	2	2
83	1·0075	0073	0071	0069	0067	0065	0063	0061	0059	0057	0	1	1	1	2
84	1·0055	0053	0051	0050	0048	0046	0045	0043	0041	0040	0	1	1	1	1
85	1·0038	0037	0035	0034	0032	0031	0030	0028	0027	0026	0	0	1	1	1
86	1·0024	0023	0022	0021	0020	0019	0018	0017	0016	0015	0	0	0	1	1
87	1·0014	0013	0012	0011	0010	0010	0009	0008	0007	0007	0	0	0	1	1
88	1·0006	0006	0005	0004	0004	0003	0003	0003	0002	0002	0	0	0	0	0
89	1·0002	0001	0001	0001	0001	0000	0000	0000	0000	0000	0	0	0	0	0

NATURAL SECANTS.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
0°	1·0000	0000	0000	0000	0000	0000	0001	0001	0001	0001	0	0	0	0	0
1	1·0002	0002	0002	0003	0003	0003	0004	0004	0005	0006	0	0	0	0	0
2	1·0006	0007	0007	0008	0009	0010	0010	0011	0012	0013	0	0	0	0	0
3	1·0014	0015	0016	0017	0018	0019	0020	0021	0022	0023	0	0	1	1	1
4	1·0024	0026	0027	0028	0030	0031	0032	0034	0035	0037	0	0	1	1	1
5	1·0038	0040	0041	0043	0045	0046	0048	0050	0051	0053	0	1	1	1	1
6	1·0055	0057	0059	0061	0063	0065	0067	0069	0071	0073	0	1	1	1	2
7	1·0075	0077	0079	0082	0084	0086	0089	0091	0093	0096	0	1	1	2	2
8	1·0098	0101	0103	0106	0108	0111	0114	0116	0119	0122	0	1	1	2	2
9	1·0125	0127	0130	0133	0136	0139	0142	0145	0148	0151	0	1	1	2	2
10	1·0154	0157	0161	0164	0167	0170	0174	0177	0180	0184	1	1	2	2	3
11	1·0187	0191	0194	0198	0201	0205	0209	0212	0216	0220	1	1	2	3	3
12	1·0223	0227	0231	0235	0239	0243	0247	0251	0255	0259	1	1	2	3	3
13	1·0263	0267	0271	0276	0280	0284	0288	0293	0297	0302	1	1	2	3	4
14	1·0306	0311	0315	0320	0324	0329	0334	0338	0343	0348	1	2	2	3	4
15	1·0353	0358	0363	0367	0372	0377	0382	0388	0393	0398	1	2	3	3	4
16	1·0403	0408	0413	0419	0424	0429	0435	0440	0446	0451	1	2	3	4	5
17	1·0457	0463	0468	0474	0480	0485	0491	0497	0503	0509	1	2	3	4	5
18	1·0515	0521	0527	0533	0539	0545	0551	0557	0564	0570	1	2	3	4	5
19	1·0576	0583	0589	0595	0602	0608	0615	0622	0628	0635	1	2	3	4	5
20	1·0642	0649	0655	0662	0669	0676	0683	0690	0697	0704	1	2	3	5	6
21	1·0711	0719	0726	0733	0740	0748	0755	0763	0770	0778	1	2	4	5	6
22	1·0785	0793	0801	0808	0816	0824	0832	0840	0848	0856	1	3	4	5	6
23	1·0864	0872	0880	0888	0896	0904	0913	0921	0929	0938	1	3	4	6	7
24	1·0946	0955	0963	0972	0981	0989	0998	1007	1016	1025	1	3	4	6	7
25	1·1034	1043	1052	1061	1070	1079	1089	1098	1107	1117	2	3	5	6	8
26	1·1126	1136	1145	1155	1164	1174	1184	1194	1203	1213	2	3	5	6	8
27	1·1223	1233	1243	1253	1264	1274	1284	1294	1305	1315	2	3	5	7	9
28	1·1326	1336	1347	1357	1368	1379	1390	1401	1412	1423	2	4	5	7	9
29	1·1434	1445	1456	1467	1478	1490	1501	1512	1524	1535	2	4	6	8	9
30	1·1547	1559	1570	1582	1594	1606	1618	1630	1642	1654	2	4	6	8	10
31	1·1666	1679	1691	1703	1716	1728	1741	1753	1766	1779	2	4	6	8	10
32	1·1792	1805	1818	1831	1844	1857	1870	1883	1897	1910	2	4	7	9	11
33	1·1924	1937	1951	1964	1978	1992	2006	2020	2034	2048	2	5	7	9	12
34	1·2062	2076	2091	2105	2120	2134	2149	2163	2178	2193	2	5	7	10	12
35	1·2208	2223	2238	2253	2268	2283	2299	2314	2329	2345	3	5	8	10	13
36	1·2361	2376	2392	2408	2424	2440	2456	2472	2489	2505	3	5	8	11	13
37	1·2521	2538	2554	2571	2588	2605	2622	2639	2656	2673	3	6	8	11	14
38	1·2690	2708	2725	2742	2760	2778	2796	2813	2831	2849	3	6	9	12	15
39	1·2868	2886	2904	2923	2941	2960	2978	2997	3016	3035	3	6	9	12	16
40	1·3054	3073	3093	3112	3131	3151	3171	3190	3210	3230	3	7	10	13	16
41	1·3250	3270	3291	3311	3331	3352	3373	3393	3414	3435	3	7	10	14	17
42	1·3456	3478	3499	3520	3542	3563	3585	3607	3629	3651	4	7	11	14	18
43	1·3673	3696	3718	3741	3763	3786	3809	3832	3855	3878	4	8	11	15	19
44	1·3902	3925	3949	3972	3996	4020	4044	4069	4093	4118	4	8	12	16	20

NATURAL SECANTS.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences. 1′	2′	3′	4′	5′
45°	1·4142	4167	4192	4217	4242	4267	4293	4318	4344	4370	4	8	13	17	21
46	1·4396	4422	4448	4474	4501	4527	4554	4581	4608	4635	4	9	13	18	22
47	1·4663	4690	4718	4746	4774	4802	4830	4859	4887	4916	5	9	14	19	23
48	1·4945	4974	5003	5032	5062	5092	5121	5151	5182	5212	5	10	15	20	25
49	1·5243	5273	5304	5335	5366	5398	5429	5461	5493	5525	5	10	16	21	26
50	1·5557	5590	5622	5655	5688	5721	5755	5788	5822	5856	6	11	17	22	28
51	1·5890	5925	5959	5994	6029	6064	6099	6135	6171	6207	6	12	18	24	29
52	1·6243	6279	6316	6353	6390	6427	6464	6502	6540	6578	6	12	19	25	31
53	1·6616	6655	6694	6733	6772	6812	6852	6892	6932	6972	7	13	20	26	33
54	1·7013	7054	7095	7137	7179	7221	7263	7305	7348	7391	7	14	21	28	35
55	1·7434	7478	7522	7566	7610	7655	7700	7745	7791	7837	7	15	22	30	37
56	1·7883	7929	7976	8023	8070	8118	8166	8214	8263	8312	8	16	24	32	40
57	1·8361	8410	8460	8510	8561	8612	8663	8714	8766	8818	9	17	26	34	43
58	1·8871	8924	8977	9031	9084	9139	9194	9249	9304	9360	9	18	27	36	45
59	1·9416	9473	9530	9587	9645	9703	9762	9821	9880	9940	10	19	29	39	49
60	2·0000	0061	0122	0183	0245	0308	0371	0434	0498	0562	10	21	31	42	52
61	2·0627	0692	0757	0824	0890	0957	1025	1093	1162	1231	11	22	34	45	56
62	2·1301	1371	1441	1513	1584	1657	1730	1803	1877	1952	12	24	36	48	61
63	2·2027	2103	2179	2256	2333	2412	2490	2570	2650	2730	13	26	39	52	66
64	2·2812	2894	2976	3060	3144	3228	3314	3400	3486	3574	14	28	43	57	71
65	2·3662	3751	3841	3931	4022	4114	4207	4300	4395	4490	15	31	46	62	77
66	2·4586	4683	4780	4879	4978	5078	5180	5282	5384	5488	17	34	50	67	84
67	2·5593	5699	5805	5913	6022	6131	6242	6354	6466	6580	18	37	55	73	92
68	2·6695	6811	6927	7046	7165	7285	7407	7529	7653	7778	20	40	60	81	101
69	2·7904	8032	8161	8291	8422	8555	8688	8824	8960	9099	22	44	67	89	111
70	2·9238	9379	9521	9665	9811	9957	*0106*	*0256*	*0407*	*0561*	25	49	74	99	123
71	3·0716	0872	1030	1190	1352	1515	1681	1848	2017	2188	27	55	82	110	137
72	3·2361	2535	2712	2891	3072	3255	3440	3628	3817	4009	31	61	92	123	154
73	3·4203	4399	4598	4799	5003	5209	5418	5629	5843	6060	35	69	104	138	173
74	3·6280	6502	6727	6955	7186	7420	7657	7897	8140	8387	39	79	118	157	196
75	3·8637	8890	9147	9408	9672	9939	*0211*	*0486*	*0765*	*1048*	45	90	135	180	225
76	4·1336	1627	1923	2223	2527	2837	3150	3469	3792	4121	52	104	156	208	260
77	4·4454	4793	5137	5486	5841	6202	6569	6942	7321	7706	61	122	182	243	304
78	4·8097	8496	8901	9313	9732	*0159*	*0593*	*1034*	*1484*	*1942*	72	144	216	287	359
79	5·2408	2883	3367	3860	4362	4874	5396	5928	6470	7023	86	173	259	345	432
80	5·7588	8164	8751	9351	9963	*0589*	*1227*	*1880*	*2546*	*3228*					
81	6·3925	4637	5363	6111	6874	7655	8454	9273	*0112*	*0972*					
82	7·1853	2757	3684	4635	5611	6613	7642	8700	9787	*0905*					
83	8·2055	3238	4457	5711	7004	8337	9711	*1129*	*2593*	*4105*					
84	9·5668	7283	8955	*0685*	*2477*	*4334*	*6261*	*8260*	11·03	11·25					
85	11·47	11·71	11·95	12·20	12·47	12·75	13·03	13·34	13·65	13·99					
86	14·34	14·70	15·09	15·50	15·93	16·38	16·86	17·37	17·91	18·49					
87	19·11	19·77	20·47	21·23	22·04	22·93	23·88	24·92	26·05	27·29					
88	28·65	30·16	31·84	33·71	35·81	38·20	40·93	44·08	47·75	52·09					
89	57·30	63·66	71·62	81·85	95·49	114·6	143·2	191·0	286·5	573·0					

Owing to the rapidity with which the secant changes, mean differences cease to be useful.

NATURAL COTANGENTS.

N.B.—Subtract Mean Differences.

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
0°	Inf.	573·0	286·5	191·0	143·2	114·6	95·49	81·85	71·62	63·66	Owing to the rapidity with which cotangent changes, mean differences are of no use.				
1	57·29	52·08	47·74	44·07	40·92	38·19	35·80	33·69	31·82	30·14					
2	28·64	27·27	26·03	24·90	23·86	22·90	22·02	21·20	20·45	19·74					
3	19·08	18·46	17·89	17·34	16·83	16·35	15·89	15·46	15·06	14·67					
4	14·30	13·95	13·62	13·30	13·00	12·71	12·43	12·16	11·91	11·66					
5	11·43	11·20	10·99	10·78	10·58	10·39	10·20	10·02	9·845	9·677					
6	9·5144	3572	2052	0579	*9152*	*7769*	*6427*	*5126*	*3863*	*2636*					
7	8·1443	0285	*9158*	*8062*	*6996*	*5958*	*4947*	*3962*	*3002*	*2066*					
8	7·1154	0264	*9395*	*8548*	*7720*	*6912*	*6122*	*5350*	*4596*	*3859*					
9	6·3138	2432	1742	1066	0405	*9758*	*9124*	*8502*	*7894*	*7297*					
10	5·6713	6140	5578	5026	4486	3955	3435	2924	2422	1929					
11	5·1446	0970	0504	0045	*9594*	*9152*	*8716*	*8288*	*7867*	*7453*	74	148	222	296	370
12	4·7046	6646	6252	5864	5483	5107	4737	4374	4015	3662	63	125	188	252	314
13	4·3315	2972	2635	2303	1976	1653	1335	1022	0713	0408	53	107	160	214	267
14	4·0108	*9812*	*9520*	*9232*	*8947*	*8667*	*8391*	*8118*	*7848*	*7583*	46	93	139	186	232
15	3·7321	7062	6806	6554	6305	6059	5816	5576	5339	5105	41	82	122	163	204
16	3·4874	4646	4420	4197	3977	3759	3544	3332	3122	2914	36	72	108	144	180
17	3·2709	2506	2305	2106	1910	1716	1524	1334	1146	0961	32	64	96	129	161
18	3·0777	0595	0415	0237	0061	*9887*	*9714*	*9544*	*9375*	*9208*	29	58	87	115	144
19	2·9042	8878	8716	8556	8397	8239	8083	7929	7776	7625	26	52	78	104	130
20	2·7475	7326	7179	7034	6889	6746	6605	6464	6325	6187	24	47	71	95	118
21	2·6051	5916	5782	5649	5517	5386	5257	5129	5002	4876	22	43	65	87	108
22	2·4751	4627	4504	4383	4262	4142	4023	3906	3789	3673	20	40	60	79	99
23	2·3559	3445	3332	3220	3109	2998	2889	2781	2673	2566	18	37	55	74	92
24	2·2460	2355	2251	2148	2045	1943	1842	1742	1642	1543	17	34	51	68	85
25	2·1445	1348	1251	1155	1060	0965	0872	0778	0686	0594	16	31	47	63	78
26	2·0503	0413	0323	0233	0145	0057	*9970*	*9883*	*9797*	*9711*	15	29	44	58	73
27	1·9626	9542	9458	9375	9292	9210	9128	9047	8967	8887	14	27	41	55	68
28	1·8807	8728	8650	8572	8495	8418	8341	8265	8190	8115	13	26	38	51	64
29	1·8040	7966	7893	7820	7747	7675	7603	7532	7461	7391	12	24	36	48	60
30	1·7321	7251	7182	7113	7045	6977	6909	6842	6775	6709	11	23	34	45	56
31	1·6643	6577	6512	6447	6383	6319	6255	6191	6128	6066	11	21	32	43	53
32	1·6003	5941	5880	5818	5757	5697	5637	5577	5517	5458	10	20	30	40	50
33	1·5399	5340	5282	5224	5166	5108	5051	4994	4938	4882	10	19	29	38	48
34	1·4826	4770	4715	4659	4605	4550	4496	4442	4388	4335	9	18	27	36	45
35	1·4281	4229	4176	4124	4071	4019	3968	3916	3865	3814	9	17	26	34	43
36	1·3764	3713	3663	3613	3564	3514	3465	3416	3367	3319	8	16	25	33	41
37	1·3270	3222	3175	3127	3079	3032	2985	2938	2892	2846	8	16	23	31	39
38	1·2799	2753	2708	2662	2617	2572	2527	2482	2437	2393	8	15	23	30	38
39	1·2349	2305	2261	2218	2174	2131	2088	2045	2002	1960	7	14	22	29	36
40	1·1918	1875	1833	1792	1750	1708	1667	1626	1585	1544	7	14	21	28	34
41	1·1504	1463	1423	1383	1343	1303	1263	1224	1184	1145	7	13	20	26	33
42	1·1106	1067	1028	0990	0951	0913	0875	0837	0799	0761	6	13	19	25	32
43	1·0724	0686	0649	0612	0575	0538	0501	0464	0428	0392	6	12	18	25	31
44	1·0355	0319	0283	0247	0212	0176	0141	0105	0070	0035	6	12	18	24	30

NATURAL COTANGENTS.

***N.B.*—Subtract Mean Differences.**

	0′	6′	12′	18′	24′	30′	36′	42′	48′	54′	Mean Differences.				
											1′	2′	3′	4′	5′
45°	1·000	*9965*	*9930*	*9896*	*9861*	*9827*	*9793*	*9759*	*9725*	*9691*	6	11	17	23	29
46	·9657	9623	9590	9556	9523	9490	9457	9424	9391	9358	6	11	17	22	28
47	·9325	9293	9260	9228	9195	9163	9131	9099	9067	9036	5	11	16	21	27
48	·9004	8972	8941	8910	8878	8847	8816	8785	8754	8724	5	10	16	21	26
49	·8693	8662	8632	8601	8571	8541	8511	8481	8451	8421	5	10	15	20	25
50	·8391	8361	8332	8302	8273	8243	8214	8185	8156	8127	5	10	15	20	24
51	·8098	8069	8040	8012	7983	7954	7926	7898	7869	7841	5	10	14	19	24
52	·7813	7785	7757	7729	7701	7673	7646	7618	7590	7563	5	9	14	18	23
53	·7536	7508	7481	7454	7427	7400	7373	7346	7319	7292	5	9	14	18	23
54	·7265	7239	7212	7186	7159	7133	7107	7080	7054	7028	4	9	13	18	22
55	·7002	6976	6950	6924	6899	6873	6847	6822	6796	6771	4	9	13	17	21
56	·6745	6720	6694	6669	6644	6619	6594	6569	6544	6519	4	8	13	17	21
57	·6494	6469	6445	6420	6395	6371	6346	6322	6297	6273	4	8	12	16	20
58	·6249	6224	6200	6176	6152	6128	6104	6080	6056	6032	4	8	12	16	20
59	·6009	5985	5961	5938	5914	5890	5867	5844	5820	5797	4	8	12	16	20
60	·5774	5750	5727	5704	5681	5658	5635	5612	5589	5566	4	8	12	15	19
61	·5543	5520	5498	5475	5452	5430	5407	5384	5362	5340	4	8	11	15	19
62	·5317	5295	5272	5250	5228	5206	5184	5161	5139	5117	4	7	11	15	18
63	·5095	5073	5051	5029	5008	4986	4964	4942	4921	4899	4	7	11	15	18
64	·4877	4586	4834	4813	4791	4770	4748	4727	4706	4684	4	7	11	14	18
65	·4663	4642	4621	4599	4578	4557	4536	4515	4494	4473	4	7	10	14	18
66	·4452	4431	4411	4390	4369	4348	4327	4307	4286	4265	3	7	10	14	17
67	·4245	4224	4204	4183	4163	4142	4122	4101	4081	4061	3	7	10	14	17
68	·4040	4020	4000	3979	3959	3939	3919	3899	3879	3859	3	7	10	13	17
69	·3839	3819	3799	3779	3759	3739	3719	3699	3679	3659	3	7	10	13	17
70	·3640	3620	3600	3581	3561	3541	3522	3502	3482	3463	3	6	10	13	17
71	·3443	3424	3404	3385	3365	3346	3327	3307	3288	3269	3	6	10	13	16
72	·3249	3230	3211	3191	3172	3153	3134	3115	3096	3076	3	6	10	13	16
73	·3057	3038	3019	3000	2981	2962	2943	2924	2905	2886	3	6	9	13	16
74	·2867	2849	2830	2811	2792	2773	2754	2736	2717	2698	3	6	9	13	16
75	·2679	2661	2642	2623	2605	2586	2568	2549	2530	2512	3	6	9	12	16
76	·2493	2475	2456	2438	2419	2401	2382	2364	2345	2327	3	6	9	12	15
77	·2309	2290	2272	2254	2235	2217	2199	2180	2162	2144	3	6	9	12	15
78	·2126	2107	2089	2071	2053	2035	2016	1998	1980	1962	3	6	9	12	15
79	·1944	1926	1908	1890	1871	1853	1835	1817	1799	1781	3	6	9	12	15
80	·1763	1745	1727	1709	1691	1673	1655	1638	1620	1602	3	6	9	12	15
81	·1584	1566	1548	1530	1512	1495	1477	1459	1441	1423	3	6	9	12	15
82	·1405	1388	1370	1352	1334	1317	1299	1281	1263	1246	3	6	9	12	15
83	·1228	1210	1192	1175	1157	1139	1122	1104	1086	1069	3	6	9	12	15
84	·1051	1033	1016	0998	0981	0963	0945	0928	0910	0892	3	6	9	12	15
85	·0875	0857	0840	0822	0805	0787	0769	0752	0734	0717	3	6	9	12	15
86	·0699	0682	0664	0647	0629	0612	0594	0577	0559	0542	3	6	9	12	15
87	·0524	0507	0489	0472	0454	0437	0419	0402	0384	0367	3	6	9	12	15
88	·0349	0332	0314	0297	0279	0262	0244	0227	0209	0192	3	6	9	12	14
89	·0175	0157	0140	0122	0105	0087	0070	0052	0035	0017	3	6	9	12	15

SQUARES.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
1·0	1·000	1·020	1·040	1·061	1·082	1·103	1·124	1·145	1·166	1·188	2	4	6	8	10	13	15	17	19
1·1	1·210	1·232	1·254	1·277	1·300	1·323	1·346	1·369	1·392	1·416	2	5	7	9	11	14	16	18	21
1·2	1·440	1·464	1·488	1·513	1·538	1·563	1·588	1·613	1·638	1·664	2	5	7	10	12	15	17	20	22
1·3	1·690	1·716	1·742	1·769	1·796	1·823	1·850	1·877	1·904	1·932	3	5	8	11	13	16	19	22	24
1·4	1·960	1·988	2·016	2·045	2·074	2·103	2·132	2·161	2·190	2·220	3	6	9	12	14	17	20	23	26
1·5	2·250	2·280	2·310	2·341	2·372	2·403	2·434	2·465	2·496	2·528	3	6	9	12	15	19	22	25	28
1·6	2·560	2·592	2·624	2·657	2·690	2·723	2·756	2·789	2·822	2·856	3	7	10	13	16	20	23	26	30
1·7	2·890	2·924	2·958	2·993	3·028	3·063	3·098	3·133	3·168	3·204	3	7	10	14	17	21	24	28	31
1·8	3·240	3·276	3·312	3·349	3·386	3·423	3·460	3·497	3·534	3·572	4	7	11	15	18	22	26	30	33
1·9	3·610	3·648	3·686	3·725	3·764	3·803	3·842	3·881	3·920	3·960	4	8	12	16	19	23	27	31	35
2·0	4·000	4·040	4·080	4·121	4·162	4·203	4·244	4·285	4·326	4·368	4	8	12	16	20	25	20	33	37
2·1	4·410	4·452	4·494	4·537	4·580	4·623	4·666	4·709	4·752	4·796	4	9	13	17	21	26	30	34	39
2·2	4·840	4·884	4·928	4·973	5·018	5·063	5·108	5·153	5·198	5·244	4	9	13	18	22	27	31	36	40
2·3	5·290	5·336	5·382	5·429	5·476	5·523	5·570	5·617	5·664	5·712	5	9	14	19	23	28	33	38	42
2·4	5·760	5·808	5·856	5·905	5·954	6·003	6·052	6·101	6·150	6·200	5	10	15	20	24	29	34	39	44
2·5	6·250	6·300	6·350	6·401	6·452	6·503	6·554	6·605	6·656	6·708	5	10	15	20	25	31	36	41	46
2·6	6·760	6·812	6·864	6·917	6·970	7·023	7·076	7·129	7·182	7·236	5	11	16	21	26	32	37	42	48
2·7	7·290	7·344	7·398	7·453	7·508	7·563	7·618	7·673	7·728	7·784	5	11	16	22	27	33	38	44	49
2·8	7·840	7·896	7·952	8·009	8·066	8·123	8·180	8·237	8·294	8·352	6	11	17	23	28	34	40	46	51
2·9	8·410	8·468	8·526	8·585	8·644	8·703	8·762	8·821	8·880	8·940	6	12	18	24	29	35	41	47	53
3·0	9·000	9·060	9·120	9·181	9·242	9·303	9·364	9 425	9·486	9·548	6	12	18	24	30	37	43	49	55
3·1	9·610	9·672	9·734	9·797	9·860	9·923	9·986				6	13	19	25	31	38	44	50	57
3·1								10·05	10·11	10·18	1	1	2	3	3	4	5	5	6
3·2	10·24	10·30	10·37	10·43	10·50	10·56	10·63	10·69	10·76	10·82	1	1	2	3	3	4	5	5	6
3·3	10·89	10·96	11·02	11·09	11·16	11·22	11·29	11·36	11·42	11·49	1	1	2	3	3	4	5	5	6
3·4	11·56	11·63	11·70	11·76	11·83	11·90	11·97	12·04	12·11	12·18	1	1	2	3	3	4	5	6	6
3·5	12·25	12·32	12·39	12·46	12·53	12·60	12·67	12·74	12·82	12·89	1	1	2	3	4	4	5	6	6
3·6	12·96	13·03	13·10	13·18	13·25	13·32	13·40	13·47	13·54	13·62	1	1	2	3	4	4	5	6	7
3·7	13·69	13·76	13·84	13·91	13·99	14·06	14·14	14·21	14·29	14·36	1	2	2	3	4	5	5	6	7
3·8	14·44	14·52	14·59	14·67	14·75	14·82	14·90	14·98	15·05	15·13	1	2	2	3	4	5	5	6	7
3·9	15·21	15·29	15·37	15·44	15·52	15·60	15·68	15·76	15·84	15·92	1	2	2	3	4	5	6	6	7
4·0	16·00	16·08	16·16	16·24	16·32	16·40	16·48	16·56	16·65	16·73	1	2	2	3	4	5	6	6	7
4·1	16·81	16·89	16·97	17·06	17·14	17·22	17·31	17·39	17·47	17·56	1	2	2	3	4	5	6	7	7
4·2	17·64	17·72	17·81	17·89	17·98	18·06	18·15	18·23	18·32	18·40	1	2	3	3	4	5	6	7	8
4·3	18·49	18·58	18·66	18·75	18·84	18·92	19·01	19·10	19·18	19·27	1	2	3	3	4	5	6	7	8
4·4	19·36	19·45	19·54	19·62	19·71	19·80	19·89	19·98	20·07	20·16	1	2	3	4	5	5	6	7	8
4·5	20·25	20·34	20·43	20·52	20·61	20·70	20·79	20·88	20·98	21·07	1	2	3	4	5	5	6	7	8
4·6	21·16	21·25	21·34	21·44	21·53	21·62	21·72	21·81	21·90	22·00	1	2	3	4	5	6	7	7	8
4·7	22·09	22·18	22·28	22·37	22·47	22·56	22·66	22·75	22·85	22·94	1	2	3	4	5	6	7	8	9
4·8	23·04	23·14	23·23	23·33	23·43	23·52	23·62	23·72	23·81	23·91	1	2	3	4	5	6	7	8	9
4·9	24·01	24·11	24·21	24·30	24·40	24·50	24·60	24·70	24·80	24·90	1	2	3	4	5	6	7	8	9
5·0	25·00	25·10	25·20	25·30	25·40	25·50	25·60	25·70	25·81	25·91	1	2	3	4	5	6	7	8	9
5·1	26·01	26·11	26·21	26·32	26·42	26·52	26·63	26·73	26·83	26·94	1	2	3	4	5	6	7	8	9
5·2	27·04	27·14	27·25	27·35	27·46	27·56	27·67	27·77	27·88	27·98	1	2	3	4	5	6	7	8	9
5·3	28·09	28·20	28·30	28·41	28·52	28·62	28·73	28·84	28·94	29·05	1	2	3	4	5	6	7	9	10
5·4	29·16	29·27	29·38	29·48	29·59	29·70	29·81	29·92	30·03	30·14	1	2	3	4	6	7	8	9	10

SQUARES.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
5·5	30·25	30·36	30·47	30·58	30·69	30·80	30·91	31·02	31·14	31·25	1	2	3	4	6	7	8	9	10
5·6	31·36	31·47	31·58	31·70	31·81	31·92	32·04	32·15	32·26	32·38	1	2	3	5	6	7	8	9	10
5·7	32·49	32·60	32·72	32·83	32·95	33·06	33·18	33·29	33·41	33·52	1	2	3	5	6	7	8	9	10
5·8	33·64	33·76	33·87	33·99	34·11	34·22	34·34	34·46	34·57	34·69	1	2	4	5	6	7	8	9	11
5·9	34·81	34·93	35·05	35·16	35·28	35·40	35·52	35·64	35·76	35·88	1	2	4	5	6	7	8	10	11
6·0	36·00	36·12	36·24	36·36	36·48	36·60	36·72	36·84	36·97	37·09	1	2	4	5	6	7	9	10	11
6·1	37·21	37·33	37·45	37·58	37·70	37·82	37·95	38·07	38·19	38·32	1	2	4	5	6	7	9	10	11
6·2	38·44	38·56	38·69	38·81	38·94	39·06	39·19	39·31	39·44	39·56	1	3	4	5	6	8	9	10	11
6·3	39·69	39·82	39·94	40·07	40·20	40·32	40·45	40·58	40·70	40·83	1	3	4	5	6	8	9	10	11
6·4	40·96	41·09	41·22	41·34	41·47	41·60	41·73	41·86	41·99	42·12	1	3	4	5	6	8	9	10	12
6·5	42·25	42·38	42·51	42·64	42·77	42·90	43·03	43·16	43·30	43·43	1	3	4	5	7	8	9	10	12
6·6	43·56	43·69	43·82	43·96	44·09	44·22	44·36	44·49	44·62	44·76	1	3	4	5	7	8	9	11	12
6·7	44·89	45·02	45·16	45·29	45·43	45·56	45·70	45·83	45·97	46·10	1	3	4	5	7	8	9	11	12
6·8	46·24	46·38	46·51	46·65	46·79	46·92	47·06	47·20	47·33	47·47	1	3	4	5	7	8	10	11	12
6·9	47·61	47·75	47·89	48·02	48·16	48·30	48·44	48·58	48·72	48·86	1	3	4	6	7	8	10	11	13
7·0	49·00	49·14	49·28	49·42	49·56	49·70	49·84	49·98	50·13	50·27	1	3	4	6	7	8	10	11	13
7·1	50·41	50·55	50·69	50·84	50·98	51·12	51·27	51·41	51·55	51·70	1	3	4	6	7	9	10	11	13
7·2	51·84	51·98	52·13	52·27	52·42	52·56	52·71	52·85	53·00	53·14	1	3	4	6	7	9	10	12	13
7·3	53·29	53·44	53·58	53·73	53·88	54·02	54·17	54·32	54·46	54·61	1	3	4	6	7	9	10	12	13
7·4	54·76	54·91	55·06	55·20	55·35	55·50	55·65	55·80	55·95	56·10	1	3	4	6	7	9	10	12	13
7·5	56·25	56·40	56·55	56·70	56·85	57·00	57·15	57·30	57·46	57·61	2	3	5	6	8	9	11	12	14
7·6	57·76	57·91	58·06	58·22	58·37	58·52	58·68	58·83	58·98	59·14	2	3	5	6	8	9	11	12	14
7·7	59·29	59·44	59·60	59·75	59·91	60·06	60·22	60·37	60·53	60·68	2	3	5	6	8	9	11	12	14
7·8	60·84	61·00	61·15	61·31	61·47	61·62	61·78	61·94	62·09	62·25	2	3	5	6	8	9	11	13	14
7·9	62·41	62·57	62·73	62·88	63·04	63·20	63·36	63·52	63·68	63·84	2	3	5	6	8	10	11	13	14
8·0	64·00	64·16	64·32	64·48	64·64	64·80	64·96	65·12	65·29	65·45	2	3	5	6	8	10	11	13	14
8·1	65·61	65·77	65·93	66·10	66·26	66·42	66·59	66·75	66·91	67·08	2	3	5	7	8	10	11	13	15
8·2	67·24	67·40	67·57	67·73	67·90	68·06	68·23	68·39	68·56	68·72	2	3	5	7	8	10	12	13	15
8·3	68·89	69·06	69·22	69·39	69·56	69·72	69·89	70·06	70·22	70·39	2	3	5	7	8	10	12	13	15
8·4	70·56	70·73	70·90	71·06	71·23	71·40	71·57	71·74	71·91	72·08	2	3	5	7	8	10	12	14	15
8·5	72·25	72·42	72·59	72·76	72·93	73·10	73·27	73·44	73·62	73·79	2	3	5	7	9	10	12	14	15
8·6	73·96	74·13	74·30	74·48	74·65	74·82	75·00	75·17	75·34	75·52	2	3	5	7	9	10	12	14	16
8·7	75·69	75·86	76·04	76·21	76·39	76·56	76·74	76·91	77·09	77·26	2	4	5	7	9	11	12	14	16
8·8	77·44	77·62	77·79	77·97	78·15	78·32	78·50	78·68	78·85	79·03	2	4	5	7	9	11	12	14	16
8·9	79·21	79·39	79·57	79·74	79·92	80·10	80·28	80·46	80·64	80·82	2	4	5	7	9	11	13	14	16
9·0	81·00	81·18	81·36	81·54	81·72	81·90	82·08	82·26	82·45	82·63	2	4	5	7	9	11	13	14	16
9·1	82·81	82·99	83·17	83·36	83·54	83·72	83·91	84·09	84·27	84·46	2	4	5	7	9	11	13	15	16
9·2	84·64	84·82	85·01	85·19	85·38	85·56	85·75	85·93	86·12	86·30	2	4	6	7	9	11	13	15	17
9·3	86·49	86·68	86·86	87·05	87·24	87·42	87·61	87·80	87·98	88·17	2	4	6	7	9	11	13	15	17
9·4	88·36	88·55	88·74	88·92	89·11	89·30	89·49	89·68	89·87	90·06	2	4	6	8	9	11	13	15	17
9·5	90·25	90·44	90·63	90·82	91·01	91·20	91·39	91·58	91·78	91·97	2	4	6	8	10	11	13	15	17
9·6	92·16	92·35	92·54	92·74	92·93	93·12	93·32	93·51	93·70	93·90	2	4	6	8	10	12	14	15	17
9·7	94·09	94·28	94·48	94·67	94·87	95·06	95·26	95·45	95·65	95·84	2	4	6	8	10	12	14	16	18
9·8	96·04	96·24	96·43	96·63	96·83	97·02	97·22	97·42	97·61	97·81	2	4	6	8	10	12	14	16	18
9·9	98·01	98·21	98·41	98·60	98·80	99·00	99·20	99·40	99·60	99·80	2	4	6	8	10	12	14	16	18

SQUARE ROOTS FROM 100 TO 999·9.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
10	10·00	10·05	10·10	10·15	10·20	10·25	10·30	10·34	10·39	10·44	0	1	1	2	2	3	3	4	4
11	10·49	10·54	10·58	10·63	10·68	10·72	10·77	10·82	10·86	10·91	0	1	1	2	2	3	3	4	4
12	10·95	11·00	11·05	11·09	11·14	11·18	11·22	11·27	11·31	11·36	0	1	1	2	2	3	3	4	4
13	11·40	11·45	11·49	11·53	11·58	11·62	11·66	11·70	11·75	11·79	0	1	1	2	2	3	3	3	4
14	11·83	11·87	11·92	11·96	12·00	12·04	12·08	12·12	12·17	12·21	0	1	1	2	2	2	3	3	4
15	12·25	12·29	12·33	12·37	12·41	12·45	12·49	12·53	12·57	12·61	0	1	1	2	2	2	3	3	4
16	12·65	12·69	12·73	12·77	12·81	12·85	12·88	12·92	12·96	13·00	0	1	1	2	2	2	3	3	4
17	13·04	13·08	13·11	13·15	13·19	13·23	13·27	13·30	13·34	13·38	0	1	1	2	2	2	3	3	3
18	13·42	13·45	13·49	13·53	13·56	13·60	13·64	13·67	13·71	13·75	0	1	1	1	2	2	3	3	3
19	13·78	13·82	13·86	13·89	13·93	13·96	14·00	14·04	14·07	14·11	0	1	1	1	2	2	3	3	3
20	14·14	14·18	14·21	14·25	14·28	14·32	14·35	14·39	14·42	14·46	0	1	1	1	2	2	2	3	3
21	14·49	14·53	14·56	14·59	14·63	14·66	14·70	14·73	14·76	14·80	0	1	1	1	2	2	2	3	3
22	14·83	14·87	14·90	14·93	14·97	15·00	15·03	15·07	15·10	15·13	0	1	1	1	2	2	2	3	3
23	15·17	15·20	15·23	15·26	15·30	15·33	15·36	15·39	15·43	15·46	0	1	1	1	2	2	2	3	3
24	15·49	15·52	15·56	15·59	15·62	15·65	15·68	15·72	15·75	15·78	0	1	1	1	2	2	2	3	3
25	15·81	15·84	15·87	15·91	15·94	15·97	16·00	16·03	16·06	16·09	0	1	1	1	2	2	2	3	3
26	16·12	16·16	16·19	16·22	16·25	16·28	16·31	16·34	16·37	16·40	0	1	1	1	2	2	2	2	3
27	16·43	16·46	16·49	16·52	16·55	16·58	16·61	16·64	16·67	16·70	0	1	1	1	2	2	2	2	3
28	16·73	16·76	16·79	16·82	16·85	16·88	16·91	16·94	16·97	17·00	0	1	1	1	1	2	2	2	3
29	17·03	17·06	17·09	17·12	17·15	17·18	17·20	17·23	17·26	17·29	0	1	1	1	1	2	2	2	3
30	17·32	17·35	17·38	17·41	17·44	17·46	17·49	17·52	17·55	17·58	0	1	1	1	1	2	2	2	3
31	17·61	17·64	17·66	17·69	17·72	17·75	17·78	17·80	17·83	17·86	0	1	1	1	1	2	2	2	3
32	17·89	17·92	17·94	17·97	18·00	18·03	18·06	18·08	18·11	18·14	0	1	1	1	1	2	2	2	2
33	18·17	18·19	18·22	18·25	18·28	18·30	18·33	18·36	18·38	18·41	0	1	1	1	1	2	2	2	2
34	18·44	18·47	18·49	18·52	18·55	18·57	18·60	18·63	18·65	18·68	0	1	1	1	1	2	2	2	2
35	18·71	18·73	18·76	18·79	18·81	18·84	18·87	18·89	18·92	18·95	0	1	1	1	1	2	2	2	2
36	18·97	19·00	19·03	19·05	19·08	19·10	19·13	19·16	19·18	19·21	0	1	1	1	1	2	2	2	2
37	19·24	19·26	19·29	19·31	19·34	19·36	19·39	19·42	19·44	19·47	0	1	1	1	1	2	2	2	2
38	19·49	19·52	19·54	19·57	19·60	19·62	19·65	19·67	19·70	19·72	0	1	1	1	1	2	2	2	2
39	19·75	19·77	19·80	19·82	19·85	19·87	19·90	19·92	19·95	19·97	0	1	1	1	1	2	2	2	2
40	20·00	20·02	20·05	20·07	20·10	20·12	20·15	20·17	20·20	20·22	0	0	1	1	1	1	2	2	2
41	20·25	20·27	20·30	20·32	20·35	20·37	20·40	20·42	20·45	20·47	0	0	1	1	1	1	2	2	2
42	20·49	20·52	20·54	20·57	20·59	20·62	20·64	20·66	20·69	20·71	0	0	1	1	1	1	2	2	2
43	20·74	20·76	20·78	20·81	20·83	20·86	20·88	20·90	20·93	20·95	0	0	1	1	1	1	2	2	2
44	20·98	21·00	21·02	21·05	21·07	21·10	21·12	21·14	21·17	21·19	0	0	1	1	1	1	2	2	2
45	21·21	21·24	21·26	21·28	21·31	21·33	21·35	21·38	21·40	21·42	0	0	1	1	1	1	2	2	2
46	21·45	21·47	21·49	21·52	21·54	21·56	21·59	21·61	21·63	21·66	0	0	1	1	1	1	2	2	2
47	21·68	21·70	21·73	21·75	21·77	21·79	21·82	21·84	21·86	21·89	0	0	1	1	1	1	2	2	2
48	21·91	21·93	21·95	21·98	22·00	22·02	22·05	22·07	22·09	22·11	0	0	1	1	1	1	2	2	2
49	22·14	22·16	22·18	22·20	22·23	22·25	22·27	22·29	22·32	22·34	0	0	1	1	1	1	2	2	2
50	22·36	22·38	22·41	22·43	22·45	22·47	22·49	22·52	22·54	22·56	0	0	1	1	1	1	2	2	2
51	22·58	22·61	22·63	22·65	22·67	22·69	22·72	22·74	22·76	22·78	0	0	1	1	1	1	2	2	2
52	22·80	22·83	22·85	22·87	22·89	22·91	22·93	22·96	22·98	23·00	0	0	1	1	1	1	2	2	2
53	23·02	23·04	23·07	23·09	23·11	23·13	23·15	23·17	23·19	23·22	0	0	1	1	1	1	2	2	2
54	23·24	23·26	23·28	23·30	23·32	23·35	23·37	23·39	23·41	23·43	0	0	1	1	1	1	1	2	2

SQUARE ROOTS FROM 100 TO 999·9.

	0	1	2	3	4	5	6	7	8	9	Mean Differences. 1	2	3	4	5	6	7	8	9
55	23·45	23·47	23·49	23·52	23·54	23·56	23·58	23·60	23·62	23·64	0	0	1	1	1	1	1	2	2
56	23·66	23·69	23·71	23·73	23·75	23·77	23·79	23·81	23·83	23·85	0	0	1	1	1	1	1	2	2
57	23·87	23·90	23·92	23·94	23·96	23·98	24·00	24·02	24·04	24·06	0	0	1	1	1	1	1	2	2
58	24·08	24·10	24·12	24·15	24·17	24·19	24·21	24·23	24·25	24·27	0	0	1	1	1	1	1	2	2
59	24·29	24·31	24·33	24·35	24·37	24·39	24·41	24·43	24·45	24·47	0	0	1	1	1	1	1	2	2
60	24·49	24·52	24·54	24·56	24·58	24·60	24·62	24·64	24·66	24·68	0	0	1	1	1	1	1	2	2
61	24·70	24·72	24·74	24·76	24·78	24·80	24·82	24·84	24·86	24·88	0	0	1	1	1	1	1	2	2
62	24·90	24·92	24·94	24·96	24·98	25·00	25·02	25·04	25·06	25·08	0	0	1	1	1	1	1	2	2
63	25·10	25·12	25·14	25·16	25·18	25·20	25·22	25·24	25·26	25·28	0	0	1	1	1	1	1	2	2
64	25·30	25·32	25·34	25·36	25·38	25·40	25·42	25·44	25·46	25·48	0	0	1	1	1	1	1	2	2
65	25·50	25·51	25·53	25·55	25·57	25·59	25·61	25·63	25·65	25·67	0	0	1	1	1	1	1	2	2
66	25·69	25·71	25·73	25·75	25·77	25·79	25·81	25·83	25·85	25·87	0	0	1	1	1	1	1	2	2
67	25·88	25·90	25·92	25·94	25·96	25·98	26·00	26·02	26·04	26·06	0	0	1	1	1	1	1	2	2
68	26·08	26·10	26·12	26·13	26·15	26·17	26·19	26·21	26·23	26·25	0	0	1	1	1	1	1	2	2
69	26·27	26·29	26·31	26·32	26·34	26·36	26·38	26·40	26·42	26·44	0	0	1	1	1	1	1	2	2
70	26·46	26·48	26·50	26·51	26·53	26·55	26·57	26·59	26·61	26·63	0	0	1	1	1	1	1	2	2
71	26·65	26·66	26·68	26·70	26·72	26·74	26·76	26·78	26·80	26·81	0	0	1	1	1	1	1	1	2
72	26·83	26·85	26·87	26·89	26·91	26·93	26·94	26·96	26·98	27·00	0	0	1	1	1	1	1	1	2
73	27·02	27·04	27·06	27·07	27·09	27·11	27·13	27·15	27·17	27·18	0	0	1	1	1	1	1	1	2
74	27·20	27·22	27·24	27·26	27·28	27·29	27·31	27·33	27·35	27·37	0	0	1	1	1	1	1	1	2
75	27·39	27·40	27·42	27·44	27·46	27·48	27·50	27·51	27·53	27·55	0	0	1	1	1	1	1	1	2
76	27·57	27·59	27·60	27·62	27·64	27·66	27·68	27·69	27·71	27·73	0	0	1	1	1	1	1	1	2
77	27·75	27·77	27·78	27·80	27·82	27·84	27·86	27·87	27·89	27·91	0	0	1	1	1	1	1	1	2
78	27·93	27·95	27·96	27·98	28·00	28·02	28·04	28·05	28·07	28·09	0	0	1	1	1	1	1	1	2
79	28·11	28·12	28·14	28·16	28·18	28·20	28·21	28·23	28·25	28·27	0	0	1	1	1	1	1	1	2
80	28·28	28·30	28·32	28·34	28·35	28·37	28·39	28·41	28·43	28·44	0	0	1	1	1	1	1	1	2
81	28·46	28·48	28·50	28·51	28·53	28·55	28·57	28·58	28·60	28·62	0	0	1	1	1	1	1	1	2
82	28·64	28·65	28·67	28·69	28·71	28·72	28·74	28·76	28·77	28·79	0	0	1	1	1	1	1	1	2
83	28·81	28·83	28·84	28·86	28·88	28·90	28·91	28·93	28·95	28·97	0	0	1	1	1	1	1	1	2
84	28·98	29·00	29·02	29·03	29·05	29·07	29·09	29·10	29·12	29·14	0	0	1	1	1	1	1	1	2
85	29·15	29·17	29·19	29·21	29·22	29·24	29·26	29·27	29·29	29·31	0	0	1	1	1	1	1	1	2
86	29·33	29·34	29·36	29·38	29·39	29·41	29·43	29·44	29·46	29·48	0	0	1	1	1	1	1	1	2
87	29·50	29·51	29·53	29·55	29·56	29·58	29·60	29·61	29·63	29·65	0	0	1	1	1	1	1	1	2
88	29·66	29·68	29·70	29·72	29·73	29·75	29·77	29·78	29·80	29·82	0	0	1	1	1	1	1	1	2
89	29·83	29·85	29·87	29·88	29·90	29·92	29·93	29·95	29·97	29·98	0	0	1	1	1	1	1	1	2
90	30·00	30·02	30·03	30·05	30·07	30·08	30·10	30·12	30·13	30·15	0	0	0	1	1	1	1	1	1
91	30·17	30·18	30·20	30·22	30·23	30·25	30·27	30·28	30·30	30·32	0	0	0	1	1	1	1	1	1
92	30·33	30·35	30·36	30·38	30·40	30·41	30·43	30·45	30·46	30·48	0	0	0	1	1	1	1	1	1
93	30·50	30·51	30·53	30·55	30·56	30·58	30·59	30·61	30·63	30·64	0	0	0	1	1	1	1	1	1
94	30·66	30·68	30·69	30·71	30·72	30·74	30·76	30·77	30·79	30·81	0	0	0	1	1	1	1	1	1
95	30·82	30·84	30·85	30·87	30·89	30·90	30·92	30·94	30·95	30·97	0	0	0	1	1	1	1	1	1
96	30·98	31·00	31·02	31·03	31·05	31·06	31·08	31·10	31·11	31·13	0	0	0	1	1	1	1	1	1
97	31·14	31·16	31·18	31·19	31·21	31·22	31·24	31·26	31·27	31·29	0	0	0	1	1	1	1	1	1
98	31·30	31·32	31·34	31·35	31·37	31·38	31·40	31·42	31·43	31·45	0	0	0	1	1	1	1	1	1
99	31·46	31·48	31·50	31·51	31·53	31·54	31·56	31·58	31·59	31·61	0	0	0	1	1	1	1	1	1

SQUARE ROOTS FROM 1000 TO 9999.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
10	31·62	31·78	31·94	32·09	32·25	32·40	32·56	32·71	32·86	33·02	2	3	5	6	8	9	11	12	14
11	33·17	33·32	33·47	33·62	33·76	33·91	34·06	34·21	34·35	34·50	1	3	4	6	7	9	10	12	13
12	34·64	34·79	34·93	35·07	35·21	35·36	35·50	35·64	35·78	35·92	1	3	4	6	7	8	10	11	13
13	36·06	36·19	36·33	36·47	36·61	36·74	36·88	37·01	37·15	37·28	1	3	4	5	7	8	10	11	12
14	37·42	37·55	37·68	37·82	37·95	38·08	38·21	38·34	38·47	38·60	1	3	4	5	7	8	9	11	12
15	38·73	38·86	38·99	39·12	39·24	39·37	39·50	39·62	39·75	39·87	1	3	4	5	6	8	9	10	11
16	40·00	40·12	40·25	40·37	40·50	40·62	40·74	40·87	40·99	41·11	1	2	4	5	6	7	9	10	11
17	41·23	41·35	41·47	41·59	41·71	41·83	41·95	42·07	42·19	42·31	1	2	4	5	6	7	8	10	11
18	42·43	42·54	42·66	42·78	42·90	43·01	43·13	43·24	43·36	43·47	1	2	3	5	6	7	8	9	10
19	43·59	43·70	43·82	43·93	44·05	44·16	44·27	44·38	44·50	44·61	1	2	3	5	6	7	8	9	10
20	44·72	44·83	44·04	45·06	45·17	45·28	45·39	45·50	45·61	45·72	1	2	3	4	6	7	8	9	10
21	45·83	45·93	46·04	46·15	46·26	46·37	46·48	46·58	46·69	46·80	1	2	3	4	5	6	8	9	10
22	46·90	47·01	47·12	47·22	47·33	47·43	47·54	47·04	47·75	47·85	1	2	3	4	5	6	7	8	9
23	47·96	48·06	48·17	48·27	48·37	48·48	48·58	48·68	48·79	48·89	1	2	3	4	5	6	7	8	9
24	48·99	49·09	49·19	49·30	49·40	49·50	49·60	49·70	49·80	49·90	1	2	3	4	5	6	7	8	9
25	50·00	50·10	50·20	50·30	50·40	50·50	50·60	50·70	50·79	50·89	1	2	3	4	5	6	7	8	9
26	50·99	51·09	51·19	51·28	51·38	51·48	51·58	51·67	51·77	51·87	1	2	3	4	5	6	7	8	9
27	51·96	52·06	52·15	52·25	52·35	52·44	52·54	52·63	52·73	52·82	1	2	3	4	5	6	7	8	9
28	52·92	53·01	53·10	53·20	53·29	53·39	53·48	53·57	53·67	53·76	1	2	3	4	5	6	7	7	8
29	53·85	53·94	54·04	54·13	54·22	54·31	54·41	54·50	54·59	54·68	1	2	3	4	5	5	6	7	8
30	54·77	54·86	54·95	55·05	55·14	55·23	55·32	55·41	55·50	55·59	1	2	3	4	4	5	6	7	8
31	55·68	55·77	55·86	55·95	56·04	56·12	56·21	56·30	56·39	56·48	1	2	3	3	4	5	6	7	8
32	56·57	56·66	56·75	56·83	56·92	57·01	57·10	57·18	57·27	57·36	1	2	3	3	4	5	6	7	8
33	57·45	57·53	57·62	57·71	57·79	57·88	57·97	58·05	58·14	58·22	1	2	3	3	4	5	6	7	8
34	58·31	58·40	58·48	58·57	58·65	58·74	58·82	58·91	58·99	59·08	1	2	3	3	4	5	6	7	8
35	59·16	59·25	59·33	59·41	59·50	59·58	59·67	59·75	59·83	59·92	1	2	2	3	4	5	6	7	8
36	60·00	60·08	60·17	60·25	60·33	60·42	60·50	60·58	60·66	60·75	1	2	2	3	4	5	6	7	7
37	60·83	60·91	60·99	61·07	61·16	61·24	61·32	61·40	61·48	61·56	1	2	2	3	4	5	6	7	7
38	61·64	61·73	61·81	61·89	61·97	62·05	62·13	62·21	62·29	62·37	1	2	2	3	4	5	6	6	7
39	62·45	62·53	62·61	62·69	62·77	62·85	62·93	63·01	63·09	63·17	1	2	2	3	4	5	6	6	7
40	63·25	63·32	63·40	63·48	63·56	63·64	63·72	63·80	63·87	63·95	1	2	2	3	4	5	6	6	7
41	64·03	64·11	64·19	64·27	64·34	64·42	64·50	64·58	64·65	64·73	1	2	2	3	4	5	5	6	7
42	64·81	64·88	64·96	65·04	65·12	65·19	65·27	65·35	65·42	65·50	1	2	2	3	4	5	5	6	7
43	65·57	65·05	65·73	65·80	65·88	65·95	66·03	66·11	66·18	66·26	1	2	2	3	4	5	5	6	7
44	66·33	66·41	66·48	66·56	66·63	66·71	66·78	66·86	66·93	67·01	1	2	2	3	4	5	5	6	7
45	67·08	67·16	67·23	67·31	67·38	67·45	67·53	67·60	67·68	67·75	1	1	2	3	4	4	5	6	7
46	67·82	67·90	67·97	68·04	68·12	68·19	68·26	68·34	68·41	68·48	1	1	2	3	4	4	5	6	7
47	68·56	68·63	68·70	68·77	68·85	68·92	68·99	69·07	69·14	69·21	1	1	2	3	4	4	5	6	7
48	69·28	69·35	69·43	69·50	69·57	69·64	69·71	69·79	69·86	69·93	1	1	2	3	4	4	5	6	6
49	70·00	70·07	70·14	70·21	70·29	70·36	70·43	70·50	70·57	70·64	1	1	2	3	4	4	5	6	6
50	70·71	70·78	70·85	70·92	70·99	71·06	71·13	71·20	71·27	71·34	1	1	2	3	4	4	5	6	6
51	71·41	71·48	71·55	71·62	71·69	71·76	71·83	71·90	71·97	72·04	1	1	2	3	4	4	5	6	6
52	72·11	72·18	72·25	72·32	72·39	72·46	72·53	72·59	72·66	72·73	1	1	2	3	3	4	5	6	6
53	72·80	72·87	72·94	73·01	73·08	73·14	73·21	73·28	73·35	73·42	1	1	2	3	3	4	5	5	6
54	73·48	73·55	73·62	73·69	73·76	73·82	73·89	73·96	74·03	74·09	1	1	2	3	3	4	5	5	6

SQUARE ROOTS FROM 1000 TO 9999.

	0	1	2	3	4	5	6	7	8	9	Mean Differences.								
											1	2	3	4	5	6	7	8	9
55	74·16	74·23	74·30	74·36	74·43	74·50	74·57	74·63	74·70	74·77	1	1	2	3	3	4	5	5	6
56	74·83	74·90	74·97	75·03	75·10	75·17	75·23	75·30	75·37	75·43	1	1	2	3	3	4	5	5	6
57	75·50	75·56	75·63	75·70	75·76	75·83	75·89	75·96	76·03	76·09	1	1	2	3	3	4	5	5	6
58	76·16	76·22	76·29	76·35	76·42	76·49	76·55	76·62	76·68	76·75	1	1	2	3	3	4	5	5	6
59	76·81	76·88	76·94	77·01	77·07	77·14	77·20	77·27	77·33	77·40	1	1	2	3	3	4	4	5	6
60	77·46	77·52	77·59	77·65	77·72	77·78	77·85	77·91	77·97	78·04	1	1	2	3	3	4	4	5	6
61	78·10	78·17	78·23	78·29	78·36	78·42	78·49	78·55	78·61	78·68	1	1	2	3	3	4	4	5	6
62	78·74	78·80	78·87	78·93	78·99	79·06	79·12	79·18	79·25	79·31	1	1	2	3	3	4	4	5	6
63	79·37	79·44	79·50	79·56	79·62	79·69	79·75	79·81	79·87	79·94	1	1	2	3	3	4	4	5	6
64	80·00	80·06	80·12	80·19	80·25	80·31	80·37	80·44	80·50	80·56	1	1	2	2	3	4	4	5	6
65	80·62	80·68	80·75	80·81	80·87	80·93	80·99	81·06	81·12	81·18	1	1	2	2	3	4	4	5	5
66	81·24	81·30	81·36	81·42	81·49	81·55	81·61	81·67	81·73	81·79	1	1	2	2	3	4	4	5	5
67	81·85	81·91	81·98	82·04	82·10	82·16	82·22	82·28	82·34	82·40	1	1	2	2	3	4	4	5	5
68	82·46	82·52	82·58	82·64	82·70	82·76	82·83	82·89	82·95	83·01	1	1	2	2	3	4	4	5	5
69	83·07	83·13	83·19	83·25	83·31	83·37	83·43	83·49	83·55	83·61	1	1	2	2	3	4	4	5	5
70	83·67	83·73	83·79	83·85	83·90	83·96	84·02	84·08	84·14	84·20	1	1	2	2	3	4	4	5	5
71	84·26	84·32	84·38	84·44	84·50	84·56	84·62	84·68	84·73	84·79	1	1	2	2	3	4	4	5	5
72	84·85	84·91	84·97	85·03	85·09	85·15	85·21	85·26	85·32	85·38	1	1	2	2	3	3	4	5	5
73	85·44	85·50	85·56	85·62	85·67	85·73	85·79	85·85	85·91	85·97	1	1	2	2	3	3	4	5	5
74	86·02	86·08	86·14	86·20	86·26	86·31	86·37	86·43	86·49	86·54	1	1	2	2	3	3	4	5	5
75	86·60	86·66	86·72	86·78	86·83	86·89	86·95	87·01	87·06	87·12	1	1	2	2	3	3	4	5	5
76	87·18	87·24	87·29	87·35	87·41	87·46	87·52	87·58	87·64	87·69	1	1	2	2	3	3	4	5	5
77	87·75	87·81	87·86	87·92	87·98	88·03	88·09	88·15	88·20	88·26	1	1	2	2	3	3	4	4	5
78	88·32	88·37	88·43	88·49	88·54	88·60	88·66	88·71	88·77	88·83	1	1	2	2	3	3	4	4	5
79	88·88	88·94	88·99	89·05	89·11	89·16	89·22	89·27	89·33	89·39	1	1	2	2	3	3	4	4	5
80	89·44	89·50	89·55	89·61	89·67	89·72	89·78	89·83	89·89	89·94	1	1	2	2	3	3	4	4	5
81	90·00	90·06	90·11	90·17	90·22	90·28	90·33	90·39	90·44	90·50	1	1	2	2	3	3	4	4	5
82	90·55	90·61	90·66	90·72	90·77	90·83	90·88	90·94	90·99	91·05	1	1	2	2	3	3	4	4	5
83	91·10	91·16	91·21	91·27	91·32	91·38	91·43	91·49	91·54	91·60	1	1	2	2	3	3	4	4	5
84	91·65	91·71	91·76	91·82	91·87	91·92	91·98	92·03	92·09	92·14	1	1	2	2	3	3	4	4	5
85	92·20	92·25	92·30	92·36	92·41	92·47	92·52	92·57	92·63	92·68	1	1	2	2	3	3	4	4	5
86	92·74	92·79	92·84	92·90	92·95	93·01	93·06	93·11	93·17	93·22	1	1	2	2	3	3	4	4	5
87	93·27	93·33	93·38	93·43	93·49	93·54	93·59	93·65	93·70	93·75	1	1	2	2	3	3	4	4	5
88	93·81	93·86	93·91	93·97	94·02	94·07	94·13	94·18	94·23	94·29	1	1	2	2	3	3	4	4	5
89	94·34	94·39	94·45	94·50	94·55	94·60	94·66	94·71	94·76	94·82	1	1	2	2	3	3	4	4	5
90	94·87	94·92	94·97	95·03	95·08	95·13	95·18	95·24	95·29	95·34	1	1	2	2	3	3	4	4	5
91	95·39	95·45	95·50	95·55	95·60	95·66	95·71	95·76	95·81	95·86	1	1	2	2	3	3	4	4	5
92	95·92	95·97	96·02	96·07	96·12	96·18	96·23	96·28	96·33	96·38	1	1	2	2	3	3	4	4	5
93	96·44	96·49	96·54	96·59	96·64	96·70	96·75	96·80	96·85	96·90	1	1	2	2	3	3	4	4	5
94	96·95	97·01	97·06	97·11	97·16	97·21	97·26	97·31	97·37	97·42	1	1	2	2	3	3	4	4	5
95	97·47	97·52	97·57	97·62	97·67	97·72	97·78	97·83	97·88	97·93	1	1	2	2	3	3	4	4	5
96	97·98	98·03	98·08	98·13	98·18	98·23	98·29	98·34	98·39	98·44	1	1	2	2	3	3	4	4	5
97	98·49	98·54	98·59	98·64	98·69	98·74	98·79	98·84	98·89	98·94	1	1	2	2	3	3	4	4	5
98	98·99	99·05	99·10	99·15	99·20	99·25	99·30	99·35	99·40	99·45	0	1	1	2	2	3	3	4	4
99	99·50	99·55	99·60	99·65	99·70	99·75	99·80	99·85	99·90	99·95	0	1	1	2	2	3	3	4	4

CUBES OF NUMBERS FROM 1 TO 249.

No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.
		50	125000	100	1000000	150	3375000	200	8000000
1	1	51	132651	101	1030301	151	3442951	201	8120601
2	8	52	140608	102	1061208	152	3511808	202	8242408
3	27	53	148877	103	1092727	153	3581577	203	8365427
4	64	54	157464	104	1124864	154	3652264	204	8489664
5	125	55	166375	105	1157625	155	3723875	205	8615125
6	216	56	175616	106	1191016	156	3796416	206	8741816
7	343	57	185193	107	1225043	157	3869893	207	8869743
8	512	58	195112	108	1259712	158	3944312	208	8998912
9	729	59	205379	109	1295029	159	4019679	209	9129329
10	1000	60	216000	110	1331000	160	4096000	210	9261000
11	1331	61	226981	111	1367631	161	4173281	211	9393931
12	1728	62	238328	112	1404928	162	4251528	212	9528128
13	2197	63	250047	113	1442897	163	4330747	213	9663597
14	2744	64	262144	114	1481544	164	4410944	214	9800344
15	3375	65	274625	115	1520875	165	4492125	215	9938375
16	4096	66	287496	116	1560896	166	4574296	216	10077696
17	4913	67	300763	117	1601613	167	4657463	217	10218313
18	5832	68	314432	118	1643032	168	4741632	218	10360232
19	6859	69	328509	119	1685159	169	4826809	219	10503459
20	8000	70	343000	120	1728000	170	4913000	220	10648000
21	9261	71	357911	121	1771561	171	5000211	221	10793861
22	10648	72	373248	122	1815848	172	5088448	222	10941048
23	12167	73	389017	123	1860867	173	5177717	223	11089567
24	13824	74	405224	124	1906624	174	5268024	224	11239424
25	15625	75	421875	125	1953125	175	5359375	225	11390625
26	17576	76	438976	126	2000376	176	5451776	226	11543176
27	19683	77	456533	127	2048383	177	5545233	227	11697083
28	21952	78	474552	128	2097152	178	5639752	228	11852352
29	24389	79	493039	129	2146689	179	5735339	229	12008989
30	27000	80	512000	130	2197000	180	5832000	230	12167000
31	29791	81	531441	131	2248091	181	5929741	231	12326391
32	32768	82	551368	132	2299968	182	6028568	232	12487168
33	35937	83	571787	133	2352637	183	6128487	233	12649337
34	39304	84	592704	134	2406104	184	6229504	234	12812904
35	42875	85	614125	135	2460375	185	6331625	235	12977875
36	46656	86	636056	136	2515456	186	6434856	236	13144256
37	50653	87	658503	137	2571353	187	6539203	237	13312053
38	54872	88	681472	138	2628072	188	6644672	238	13481272
39	59319	89	704969	139	2685619	189	6751269	239	13651919
40	64000	90	729000	140	2744000	190	6859000	240	13824000
41	68921	91	753571	141	2803221	191	6967871	241	13997521
42	74088	92	778688	142	2863288	192	7077888	242	14172488
43	79507	93	804357	143	2924207	193	7189057	243	14348907
44	85184	94	830584	144	2985984	194	7301384	244	14526784
45	91125	95	857375	145	3048625	195	7414875	245	14706125
46	97336	96	884736	146	3112136	196	7529536	246	14886936
47	103823	97	912673	147	3176523	197	7645373	247	15069223
48	110592	98	941192	148	3241792	198	7762392	248	15252992
49	117649	99	970299	149	3307949	199	7880599	249	15438249

CUBES OF NUMBERS FROM 250 TO 499.

No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.
250	15625000	300	27000000	350	42875000	400	64000000	450	91125000
251	15813251	301	27270901	351	43243551	401	64481201	451	91733851
252	16003008	302	27543608	352	43614208	402	64964808	452	92345408
253	16194277	303	27818127	353	43986977	403	65450827	453	92959677
254	16387064	304	28094464	354	44361864	404	65939264	454	93576664
255	16581375	305	28372625	355	44738875	405	66430125	455	94196375
256	16777216	306	28652616	356	45118016	406	66923416	456	94818816
257	16974593	307	28934443	357	45499293	407	67419143	457	95443993
258	17173512	308	29218112	358	45882712	408	67917312	458	96071912
259	17373979	309	29503629	359	46268279	409	68417929	459	96702579
260	17576000	310	29791000	360	46656000	410	68921000	460	97336000
261	17779581	311	30080231	361	47045881	411	69426531	461	97972181
262	17984728	312	30371328	362	47437928	412	69934528	462	98611128
263	18191447	313	30664297	363	47832147	413	70444997	463	99252847
264	18399744	314	30959144	364	48228544	414	70957944	464	99897344
265	18609625	315	31255875	365	48627125	415	71473375	465	100544625
266	18821096	316	31554496	366	49027896	416	71991296	466	101194696
267	19034163	317	31855013	367	49430863	417	72511713	467	101847563
268	19248832	318	32157432	368	49836032	418	73034632	468	102503232
269	19465109	319	32461759	369	50243409	419	73560059	469	103161709
270	19683000	320	32768000	370	50653000	420	74088000	470	103823000
271	19902511	321	33076161	371	51064811	421	74618461	471	104487111
272	20123648	322	33386248	372	51478848	422	75151448	472	105154048
273	20346417	323	33698267	373	51895117	423	75686967	473	105823817
274	20570824	324	34012224	374	52313624	424	76225024	474	106496424
275	20796875	325	34328125	375	52734375	425	76765625	475	107171875
276	21024576	326	34645976	376	53157376	426	77308776	476	107850176
277	21253933	327	34965783	377	53582633	427	77854483	477	108531333
278	21484952	328	35287552	378	54010152	428	78402752	478	109215352
279	21717639	329	35611289	379	54439939	429	78953589	479	109902239
280	21952000	330	35937000	380	54872000	430	79507000	480	110592000
281	22188041	331	36264691	381	55306341	431	80062991	481	111284641
282	22425768	332	36594368	382	55742968	432	80621568	482	111980168
283	22665187	333	36926037	383	56181887	433	81182737	483	112678587
284	22906304	334	37259704	384	56623104	434	81746504	484	113379904
285	23149125	335	37595375	385	57066625	435	82312875	485	114084125
286	23393656	336	37933056	386	57512456	436	82881856	486	114791256
287	23639903	337	38272753	387	57960603	437	83453453	487	115501303
288	23887872	338	38614472	388	58411072	438	84027672	488	116214272
289	24137569	339	38958219	389	58863869	439	84604519	489	116930169
290	24389000	340	39304000	390	59319000	440	85184000	490	117649000
291	24642171	341	39651821	391	59776471	441	85766121	491	118370771
292	24897088	342	40001688	392	60236288	442	86350888	492	119095488
293	25153757	343	40353607	393	60698457	443	86938307	493	119823157
294	25412184	344	40707584	394	61162984	444	87528384	494	120553784
295	25672375	345	41063625	395	61629875	445	88121125	495	121287375
296	25934336	346	41421736	396	62099136	446	88716536	496	122023936
297	26198073	347	41781923	397	62570773	447	89314623	497	122763473
298	26463592	348	42144192	398	63044792	448	89915392	498	123505992
299	26730899	349	42508549	399	63521199	449	90518849	499	124251499

CUBES OF NUMBERS FROM 500 TO 749.

No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.
500	125000000	**550**	166375000	**600**	216000000	**650**	274625000	**700**	343000000
501	125751501	**551**	167284151	**601**	217081801	**651**	275894451	**701**	344472101
502	126506008	**552**	168196608	**602**	218167208	**652**	277167808	**702**	345948408
503	127263527	**553**	169112377	**603**	219256227	**653**	278445077	**703**	347428927
504	128024064	**554**	170031464	**604**	220348864	**654**	279726264	**704**	348913664
505	128787625	**555**	170953875	**605**	221445125	**655**	281011375	**705**	350402625
506	129554216	**556**	171879616	**606**	222545016	**656**	282300416	**706**	351895816
507	130323843	**557**	172808693	**607**	223648543	**657**	283593393	**707**	353393243
508	131096512	**558**	173741112	**608**	224755712	**658**	284890312	**708**	354894912
509	131872229	**559**	174676879	**609**	225866529	**659**	286191179	**709**	356400829
510	132651000	**560**	175616000	**610**	226981000	**660**	287496000	**710**	357911000
511	133432831	**561**	176558481	**611**	228099131	**661**	288804781	**711**	359425431
512	134217728	**562**	177504328	**612**	229220928	**662**	290117528	**712**	360944128
513	135005697	**563**	178453547	**613**	230346397	**663**	291434247	**713**	362467097
514	135796744	**564**	179406144	**614**	231475544	**664**	292754944	**714**	363994344
515	136590875	**565**	180362125	**615**	232608375	**665**	294079625	**715**	365525875
516	137388096	**566**	181321496	**616**	233744896	**666**	295408296	**716**	367061696
517	138188413	**567**	182284263	**617**	234885113	**667**	296740963	**717**	368601813
518	138991832	**568**	183250432	**618**	236029032	**668**	298077632	**718**	370146232
519	139798359	**569**	184220009	**619**	237176659	**669**	299418309	**719**	371694959
520	140608000	**570**	185193000	**620**	238328000	**670**	300763000	**720**	373248000
521	141420761	**571**	186169411	**621**	239483061	**671**	302111711	**721**	374805361
522	142236648	**572**	187149248	**622**	240641848	**672**	303464448	**722**	376367048
523	143055667	**573**	188132517	**623**	241804367	**673**	304821217	**723**	377933067
524	143877824	**574**	189119224	**624**	242970624	**674**	306182024	**724**	379503424
525	144703125	**575**	190109375	**625**	244140625	**675**	307546875	**725**	381078125
526	145531576	**576**	191102976	**626**	245314376	**676**	308915776	**726**	382657176
527	146363183	**577**	192100033	**627**	246491883	**677**	310288733	**727**	384240583
528	147197952	**578**	193100552	**628**	247673152	**678**	311665752	**728**	385828352
529	148035889	**579**	194104539	**629**	248858189	**679**	313046839	**729**	387420489
530	148877000	**580**	195112000	**630**	250047000	**680**	314432000	**730**	389017000
531	149721291	**581**	196122941	**631**	251239591	**681**	315821241	**731**	390617891
532	150568768	**582**	197137368	**632**	252435968	**682**	317214568	**732**	392223168
533	151419437	**583**	198155287	**633**	253636137	**683**	318611987	**733**	393832837
534	152273304	**584**	199176704	**634**	254840104	**684**	320013504	**734**	395446904
535	153130375	**585**	200201625	**635**	256047875	**685**	321419125	**735**	397065375
536	153990656	**586**	201230056	**636**	257259456	**686**	322828856	**736**	398688256
537	154854153	**587**	202262003	**637**	258474853	**687**	324242703	**737**	400315553
538	155720872	**588**	203297472	**638**	259694072	**688**	325660672	**738**	401947272
539	156590819	**589**	204336469	**639**	260917119	**689**	327082769	**739**	403583419
540	157464000	**590**	205379000	**640**	262144000	**690**	328509000	**740**	405224000
541	158340421	**591**	206425071	**641**	263374721	**691**	329939371	**741**	406869021
542	159220088	**592**	207474688	**642**	264609288	**692**	331373888	**742**	408518488
543	160103007	**593**	208527857	**643**	265847707	**693**	332812557	**743**	410172407
544	160989184	**594**	209584584	**644**	267089984	**694**	334255384	**744**	411830784
545	161878625	**595**	210644875	**645**	268336125	**695**	335702375	**745**	413493625
546	162771336	**596**	211708736	**646**	269586136	**696**	337153536	**746**	415160936
547	163667323	**597**	212776173	**647**	270840023	**697**	338608873	**747**	416832723
548	164566592	**598**	213847192	**648**	272097792	**698**	340068392	**748**	418508992
549	165469149	**599**	214921799	**649**	273359449	**699**	341532099	**749**	420189749

CUBES OF NUMBERS FROM 750 TO 999.

No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.	No.	Cube.
750	421875000	800	512000000	850	614125000	900	729000000	950	857375000
751	423564751	801	513922401	851	616295051	901	731432701	951	860085351
752	425259008	802	515849608	852	618470208	902	733870808	952	862801408
753	426957777	803	517781627	853	620650477	903	736314327	953	865523177
754	428661064	804	519718464	854	622835864	904	738763264	954	868250664
755	430368875	805	521660125	855	625026375	905	741217625	955	870983875
756	432081216	806	523606616	856	627222016	906	743677416	956	873722816
757	433798093	807	525557943	857	629422793	907	746142643	957	876467493
758	435519512	808	527514112	858	631628712	908	748613312	958	879217912
759	437245479	809	529475129	859	633839779	909	751089429	959	881974079
760	438976000	810	531441000	860	636056000	910	753571000	960	884736000
761	440711081	811	533411731	861	638277381	911	756058031	961	887503681
762	442450728	812	535387328	862	640503928	912	758550528	962	890277128
763	444194947	813	537367797	863	642735647	913	761048497	963	893056347
764	445943744	814	539353144	864	644972544	914	763551944	964	895841344
765	447697125	815	541343375	865	647214625	915	766060875	965	898632125
766	449455096	816	543338496	866	649461896	916	768575296	966	901428696
767	451217663	817	545338513	867	651714363	917	771095213	967	904231063
768	452984832	818	547343432	868	653972032	918	773620632	968	907039232
769	454756609	819	549353259	869	656234909	919	776151559	969	909853209
770	456533000	820	551368000	870	658503000	920	778688000	970	912673000
771	458314011	821	553387661	871	660776311	921	781229961	971	915498611
772	460099648	822	555412248	872	663054848	922	783777448	972	918330048
773	461889917	823	557441767	873	665338617	923	786330467	973	921167317
774	463684824	824	559476224	874	667627624	924	788889024	974	924010424
775	465484375	825	561515625	875	669921875	925	791453125	975	926859375
776	467288576	826	563559976	876	672221376	926	794022776	976	929714176
777	469097433	827	565609283	877	674526133	927	796597983	977	932574833
778	470910952	828	567663552	878	676836152	928	799178752	978	935441352
779	472729139	829	569722789	879	679151439	929	801765089	979	938313739
780	474552000	830	571787000	880	681472000	930	804357000	980	941192000
781	476379541	831	573856191	881	683797841	931	806954491	981	944076141
782	478211768	832	575930368	882	686128968	932	809557568	982	946966168
783	480048687	833	578009537	883	688465387	933	812166237	983	949862087
784	481890304	834	580093704	884	690807104	934	814780504	984	952763904
785	483736625	835	582182875	885	693154125	935	817400375	985	955671625
786	485587656	836	584277056	886	695506456	936	820025856	986	958585256
787	487443403	837	586376253	887	697864103	937	822656953	987	961504803
788	489303872	838	588480472	888	700227072	938	825293672	988	964430272
789	491169069	839	590589719	889	702595369	939	827936019	989	967361669
790	493039000	840	592704000	890	704969000	940	830584000	990	970299000
791	494913671	841	594823321	891	707347971	941	833237621	991	973242271
792	496793088	842	596947688	892	709732288	942	835896888	992	976191488
793	498677257	843	599077107	893	712121957	943	838561807	993	979146657
794	500566184	844	601211584	894	714516984	944	841232384	994	982107784
795	502459875	845	603351125	895	716917375	945	843908625	995	985074875
796	504358336	846	605495736	896	719323136	946	846590536	996	988047936
797	506261573	847	607645423	897	721734273	947	849278123	997	991026973
798	508169592	848	609800192	898	724150792	948	851971392	998	994011992
799	510082399	849	611960049	899	726572699	949	854670349	999	997002999

CUBES OF NUMBERS AND FRACTIONAL PARTS.

No.	0	⅛	¼	⅜	½	⅝	¾	⅞	No.
0		·0019	·0156	·0527	·1250	·2441	·4219	·6699	0
1	1	1·424	1·953	2·600	3·375	4·291	5·359	6·592	1
2	8	9·596	11·391	13 396	15·625	18·088	20·797	23·764	2
3	27	30·518	34·328	38·443	42·875	47·635	52·734	58 186	3
4	64	70·189	76·766	83·740	91·125	98·932	107·172	115·857	4
5	125	134·611	144·703	155·287	166·375	177·979	190·109	202·779	5
6	216	229·783	244·141	259·084	274·625	290 775	307·547	324·951	6
7	343	361·705	381·078	401·131	421·875	443·322	465·484	488·373	7
8	512	536·377	561·516	587·428	614·125	641·619	669·922	699·045	8
9	729	759·799	791·453	823·975	857·375	891·666	926·859	962·967	9
10	1000	1037·97	1076·89	1116·77	1157·62	1199·46	1242·30	1286·14	10
11	1331	1376·89	1423·83	1471·82	1520·87	1571·01	1622·23	1674·56	11
12	1728	1782·56	1838·27	1895·11	1953·12	2012·31	2072·67	2134·23	12
13	2197	2260·99	2326·20	2392·66	2460 37	2529·35	2599·61	2671·15	13
14	2744	2818·16	2893·64	2970·46	3048·62	3128·15	3209·05	3291·33	14
15	3375	3460·08	3546·58	3634·51	3723·87	3814·70	3906·98	4000·75	15
16	4096	4192·75	4291·02	4390·80	4492·12	4594·99	4699·42	4805·42	16
17	4913	5022·17	5132·95	5245·35	5359·37	5475·04	5592·36	5711·34	17
18	5832	5954·35	6078·39	6204·15	6331·62	6460·84	6591·80	6724·51	18
19	6859	6995·27	7133·33	7273·19	7414·87	7558·38	7703·73	7850·94	19
20	8000	8150·94	8303·77	8458·49	8615·12	8773·68	8934·17	9096·61	20
21	9261	9427·36	9595·70	9766·04	9938·37	10112·7	10289·1	10467·5	21
22	10648	10830·5	11015·1	11201·8	11390·6	11581·5	11774·5	11969·7	22
23	12167	12366·5	12568·1	12771·9	12977·9	13186·1	13396·5	13609·1	23
24	13824	14041·1	14260·5	14482·2	14706·1	14932·4	15160·9	15391·8	24
25	15625	15860·5	16098·5	16338·7	16581·4	16826·4	17073·9	17323·7	25
26	17576	17830·7	18087·9	18347·5	18609·6	18874·2	19141·3	19410·9	26
27	19683	19957·6	20234·8	20514·6	20796 9	21081·8	21369·2	21659·3	27
28	21952	22247·3	22545·3	22845·9	23149·1	23455·1	23763·7	24075·0	28
29	24389	24705·7	25025·2	25347·4	25672·4	26000·1	26330·6	26663·9	29
30	27000	27338·9	27680·6	28025·2	28372·6	28722·9	29076·0	29432·1	30

CUBES OF NUMBERS AND FRACTIONAL PARTS.

No.	0	⅛	¼	⅜	½	⅝	¾	⅞	No.
31	29791	30152·8	30517·6	30885·3	31255·9	31629·4	32006·0	32385·5	31
32	32768	33153·5	33542·0	33933·6	34328·1	34725·7	35126·4	35530·2	32
33	35937	36346·9	36760·0	37176·1	37595·4	38017·8	38443·4	38872·1	33
34	39304	39739·1	40177·4	40618·9	41063·6	41511·6	41962·8	42417·3	34
35	42875	43336·0	43800·3	44267·9	44738·9	45213·1	45690·7	46171·7	35
36	46656	47143·7	47634·8	48129·2	48627·1	49128·4	49633·2	50141·4	36
37	50653	51168·1	51686·7	52208·8	52734·4	53263·5	53796·1	54332·3	37
38	54872	55415·3	55962·1	56512·6	57066·6	57624·3	58185·6	58750·5	38
39	59319	59891·2	60467·1	61046·6	61629·9	62216·8	62807·5	63401·9	39
40	64000	64601·9	65207·5	65816·9	66430·1	67017·1	67667·9	68292·5	40
41	68921	69553·3	70189·5	70829·5	71473·4	72121·2	72772·9	73428·5	41
42	74088	74751·5	75418·9	76090·3	76765·6	77445·0	78128·3	78815·6	42
43	79507	80202·4	80901·8	81605·3	82312·9	83024·5	83740·2	84460·1	43
44	85184	85912·1	86644·3	87380·6	88121·1	88865·8	89614·7	90367·7	44
45	91125	91886·5	92652·2	93422·2	94196·4	94974·8	95757·6	96544·6	45
46	97336	98131·7	98931·6	99736·0	100545	101358	102175	102997	46
47	108823	104654	105489	106328	107172	108020	108873	109730	47
48	110592	111458	112329	113204	114084	114968	115857	116751	48
49	117649	118552	119459	120371	121287	122209	123134	124065	49
50	125000	125940	126884	127834	128788	129746	130710	131678	50
51	132651	133629	134611	135599	136591	137588	138590	139596	51
52	140608	141624	142646	143672	144703	145739	146780	147826	52
53	148877	149933	150994	152060	153130	154206	155287	156373	53
54	157464	158560	159661	160767	161879	162995	164117	165243	54
55	166375	167512	168654	169801	170954	172112	173274	174443	55
56	175616	176795	177979	179168	180362	181562	182767	183977	56
57	185193	186414	187640	188872	190109	191352	192600	193853	57
58	195112	196376	197646	198921	200202	201488	202779	204076	58
59	205379	206687	208001	209320	210645	211975	213311	214653	59
60	216000	217353	218711	220075	221445	222821	224202	225588	60

CIRCUMFERENCES OF CIRCLES ADVANCING BY EIGHTHS.

Diam.	0	1/8	1/4	3/8	1/2	5/8	3/4	7/8	Diam.
0		·3927	·7854	1·178	1·571	1·963	2·356	2·749	0
1	3·142	3·534	3·927	4·320	4·712	5·105	5·498	5·890	1
2	6·283	6·676	7·069	7·461	7·854	8·247	8·639	9·032	2
3	9·425	9·817	10·210	10·603	10·996	11·388	11·781	12·174	3
4	12·566	12·959	13·352	13·744	14·137	14·530	14·923	15·315	4
5	15·708	16·101	16·493	16·886	17·279	17·671	18·064	18·457	5
6	18·850	19·242	19·635	20·028	20·420	20·813	21·206	21·598	6
7	21·991	22·384	22·777	23·169	23·562	23·955	24·347	24·740	7
8	25·133	25·525	25·918	26·311	26·704	27·096	27·489	27·882	8
9	28·274	28·667	29·060	29·452	29·845	30·238	30·631	31·023	9
10	31·416	31·809	32·201	32·594	32·987	33·379	33·772	34·165	10
11	34·558	34·950	35·343	35·736	36·128	36·521	36·914	37·306	11
12	37·699	38·092	38·485	38·877	39·270	39·663	40·055	40·448	12
13	40·841	41·233	41·626	42·019	42·412	42·804	43·197	43·590	13
14	43·982	44·375	44·768	45·160	45·553	45·946	46·338	46·731	14
15	47·124	47·517	47·909	48·302	48·695	49·087	49·480	49·873	15
16	50·265	50·658	51·051	51·444	51·836	52·229	52·622	53·014	16
17	53·407	53·800	54·192	54·585	54·978	55·371	55·763	56·156	17
18	56·549	56·941	57·334	57·727	58·119	58·512	58·905	59·298	18
19	59·690	60·083	60·476	60·868	61·261	61·654	62·046	62·439	19
20	62·832	63·225	63·617	64·010	64·403	64·795	65·188	65·581	20
21	65·973	66·366	66·759	67·152	67·544	67·937	68·330	68·722	21
22	69·115	69·508	69·900	70·293	70·686	71·079	71·471	71·864	22
23	72·257	72·649	73·042	73·435	73·827	74·220	74·613	75·006	23
24	75·398	75·791	76·184	76·576	76·969	77·362	77·754	78·147	24
25	78·540	78·933	79·325	79·718	80·111	80·503	80·896	81·289	25
26	81·681	82·074	82·467	82·860	83·252	83·645	84·038	84·430	26
27	84·823	85·216	85·608	86·001	86·394	86·786	87·179	87·572	27
28	87·965	88·357	88·750	89·143	89·535	89·928	90·321	90·713	28
29	91·106	91·499	91·892	92·284	92·677	93·070	93·462	93·855	29
30	94·248	94·640	95·033	95·426	95·819	96·211	96·604	96·997	30
31	97·389	97·782	98·175	98·567	98·960	99·353	99·746	100·14	31
32	100·53	100·92	101·32	101·71	102·10	102·49	102·89	103·28	32
33	103·67	104·07	104·46	104·85	105·24	105·64	106·03	106·42	33
34	106·81	107·21	107·60	107·99	108·38	108·78	109·17	109·56	34
35	109·96	110·35	110·74	111·13	111·53	111·92	112·31	112·70	35
36	113·10	113·49	113·88	114·28	114·67	115·06	115·45	115·85	36
37	116·24	116·63	117·02	117·42	117·81	118·20	118·60	118·99	37
38	119·38	119·77	120·17	120·56	120·95	121·34	121·74	122·13	38
39	122·52	122·91	123·31	123·70	124·09	124·49	124·88	125·27	39
40	125·66	126·06	126·45	126·84	127·23	127·63	128·02	128·41	40
41	128·81	129·20	129·59	129·98	130·38	130·77	131·16	131·55	41
42	131·95	132·34	132·73	133·12	133·52	133·91	134·30	134·70	42
43	135·09	135·48	135·87	136·27	136·66	137·05	137·44	137·84	43
44	138·23	138·62	139·02	139·41	139·80	140·19	140·59	140·98	44
45	141·37	141·76	142·16	142·55	142·94	143·34	143·73	144·12	45
46	144·51	144·91	145·30	145·69	146·08	146·48	146·87	147·26	46
47	147·65	148·05	148·44	148·83	149·23	149·62	150·01	150·40	47
48	150·80	151·19	151·58	151·97	152·37	152·76	153·15	153·55	48
49	153·94	154·33	154·72	155·12	155·51	155·90	156·29	156·69	49
50	157·08	157·47	157·86	158·26	158·65	159·04	159·44	159·83	50

CIRCUMFERENCES OF CIRCLES ADVANCING BY EIGHTHS.

Diam.	0	1/8	1/4	3/8	1/2	5/8	3/4	7/8	Diam.
51	160·22	160·61	161·01	161·40	161·79	162·18	162·58	162·97	51
52	163·36	163·76	164·15	164·54	164·93	165·33	165·72	166·11	52
53	166·50	166·90	167·29	167·68	168·08	168·47	168·86	169·25	53
54	169·65	170·04	170·43	170·82	171·22	171·61	172·00	172·39	54
55	172·79	173·18	173·57	173·97	174·36	174·75	175·14	175·54	55
56	175·93	176·32	176·71	177·11	177·50	177·89	178·29	178·68	56
57	179·07	179·46	179·86	180·25	180·64	181·03	181·43	181·82	57
58	182·21	182·61	183·00	183·39	183·78	184·18	184·57	184·96	58
59	185·35	185·75	186·14	186·53	186·92	187·32	187·71	188·10	59
60	188·50	188·89	189·28	189·67	190·07	190·46	190·85	191·24	60
61	191·64	192·03	192·42	192·82	193·21	193·60	193·99	194·39	61
62	194·78	195·17	195·56	195·96	196·35	196·74	197·13	197·53	62
63	197·92	198·31	198·71	199·10	199·49	199·88	200·28	200·67	63
64	201·06	201·45	201·85	202·24	202·63	203·03	203·42	203·81	64
65	204·20	204·60	204·99	205·38	205·77	206·17	206·56	206·95	65
66	207·35	207·74	208·13	208·52	208·92	209·31	209·70	210·09	66
67	210·49	210·88	211·27	211·66	212·06	212·45	212·84	213·24	67
68	213·63	214·02	214·41	214·81	215·20	215·59	215·98	216·38	68
69	216·77	217·16	217·56	217·95	218·34	218·73	219·13	219·52	69
70	219·91	220·30	220·70	221·09	221·48	221·87	222·27	222·66	70
71	223·05	223·45	223·84	224·23	224·62	225·02	225·41	225·80	71
72	226·19	226·59	226·98	227·37	227·77	228·16	228·55	228·94	72
73	229·34	229·73	230·12	230·51	230·91	231·30	231·69	232·09	73
74	232·48	232·87	233·26	233·66	234·05	234·44	234·83	235·23	74
75	235·62	236·01	236·40	236·80	237·19	237·58	237·98	238·37	75
76	238·76	239·15	239·55	239·94	240·33	240·72	241·12	241·51	76
77	241·90	242·30	242·69	243·08	243·47	243·87	244·26	244·65	77
78	245·04	245·44	245·83	246·22	246·62	247·01	247·40	247·79	78
79	248·19	248·58	248·97	249·36	249·76	250·15	250·54	250·93	79
80	251·33	251·72	252·11	252·51	252·90	253·29	253·68	254·08	80
81	254·47	254·86	255·25	255·65	256·04	256·43	256·83	257·22	81
82	257·61	258·00	258·40	258·79	259·18	259·57	259·97	260·36	82
83	260·75	261·14	261·54	261·93	262·32	262·72	263·11	263·50	83
84	263·89	264·29	264·68	265·07	265·46	265·86	266·25	266·64	84
85	267·04	267·43	267·82	268·21	268·61	269·00	269·39	269·78	85
86	270·18	270·57	270·96	271·36	271·75	272·14	272·53	272·93	86
87	273·32	273·71	274·10	274·50	274·89	275·28	275·67	276·07	87
88	276·46	276·85	277·25	277·64	278·03	278·42	278·82	279·21	88
89	279·60	279·99	280·39	280·78	281·17	281·57	281·96	282·35	89
90	282·74	283·14	283·53	283·92	284·31	284·71	285·10	285·49	90
91	285·88	286·28	286·67	287·06	287·46	287·85	288·24	288·63	91
92	289·03	289·42	289·81	290·20	290·60	290·99	291·38	291·78	92
93	292·17	292·56	292·95	293·35	293·74	294·13	294·52	294·92	93
94	295·31	295·70	296·10	296·49	296·88	297·27	297·67	298·06	94
95	298·45	298·84	299·24	299·63	300·02	300·41	300·81	301·20	95
96	301·59	301·99	302·38	302·77	303·16	303·56	303·95	304·34	96
97	304·73	305·13	305·52	305·91	306·31	306·70	307·09	307·48	97
98	307·88	308·27	308·66	309·05	309·45	309·84	310·23	310·62	98
99	311·02	311·41	311·80	312·20	312·59	312·98	313·37	313·77	99
100	314·16	314·55	314·94	315·34	315·73	316·12	316·52	316·91	100

AREAS OF CIRCLES ADVANCING BY EIGHTHS.

Diam.	0	⅛	¼	⅜	½	⅝	¾	⅞	Diam.
0		·0123	·0491	·1104	·1963	·3068	·4418	·6013	0
1	·7854	·9940	1·227	1·485	1·767	2·074	2·405	2·761	1
2	3·142	3·547	3·976	4·430	4·909	5·412	5·940	6·492	2
3	7·069	7·670	8·296	8·946	9·621	10·321	11·045	11·793	3
4	12·566	13·364	14·186	15·033	15·904	16·800	17·721	18·665	4
5	19·635	20·629	21·648	22·691	23·758	24·850	25·967	27·109	5
6	28·274	29·465	30·680	31·919	33·183	34·472	35·785	37·122	6
7	38·485	39·871	41·282	42·718	44·179	45·664	47·173	48·707	7
8	50·265	51·849	53·456	55·088	56·745	58·426	60·132	61·862	8
9	63·617	65·397	67·201	69·029	70·882	72·760	74·662	76·589	9
10	78·540	80·516	82·516	84·541	86·590	88·664	90·763	92·886	10
11	95·033	97·205	99·402	101·62	103·87	106·14	108·43	110·75	11
12	113·10	115·47	117·86	120·28	122·72	125·19	127·68	130·19	12
13	132·73	135·30	137·89	140·50	143·14	145·80	148·49	151·20	13
14	153·94	156·70	159·48	162·30	165·13	167·99	170·87	173·78	14
15	176·71	179·67	182·65	185·66	188·69	191·75	194·83	197·93	15
16	201·06	204·22	207·39	210·60	213·82	217·08	220·35	223·65	16
17	226·98	230·33	233·71	237·10	240·53	243·98	247·45	250·95	17
18	254·47	258·02	261·59	265·18	268·80	272·45	276·12	279·81	18
19	283·53	287·27	291·04	294·83	298·65	302·49	306·35	310·24	19
20	314·16	318·10	322·06	326·05	330·06	334·10	338·16	342·25	20
21	346·36	350·50	354·66	358·84	363·05	367·28	371·54	375·83	21
22	380·13	384·16	388·82	393·20	397·61	402·04	406·49	410·97	22
23	415·48	420·00	424·56	429·13	433·74	438·36	443·01	447·69	23
24	452·39	457·11	461·86	466·64	471·44	476·26	481·11	485·98	24
25	490·87	495·79	500·74	505·71	510·71	515·72	520·77	525·84	25
26	530·93	536·05	541·19	546·35	551·55	556·76	562·00	567·27	26
27	572·56	577·87	583·21	588·57	593·96	599·37	604·81	610·27	27
28	615·75	621·26	626·80	632·36	637·94	643·55	649·18	654·84	28
29	660·52	666·23	671·96	677·71	683·49	689·30	695·13	700·98	29
30	706·86	712·76	718·69	724·64	730·62	736·62	742·64	748·69	30
31	754·77	760·87	766·99	773·14	779·31	785·51	791·73	797·98	31
32	804·25	810·54	816·86	823·21	829·58	835·97	842·39	848·83	32
33	855·30	861·79	868·31	874·85	881·41	888·00	894·62	901·26	33
34	907·92	914·61	921·32	928·06	934·82	941·61	948·42	955·25	34
35	962·11	969·00	975·91	982·84	989·80	996·78	1003·8	1010·8	35
36	1017·9	1025·0	1032·1	1039·2	1046·3	1053·5	1060·7	1068·0	36
37	1075·2	1082·5	1089·8	1097·1	1104·5	1111·8	1119·2	1126·7	37
38	1134·1	1141·6	1149·1	1156·6	1164·2	1171·7	1179·3	1186·9	38
39	1194·6	1202·3	1210·0	1217·7	1225·4	1233·2	1241·0	1248·8	39
40	1256·6	1264·5	1272·4	1280·3	1288·2	1290·2	1304·2	1312·2	40
41	1320·3	1328·3	1336·4	1344·5	1352·7	1360·8	1369·0	1377·2	41
42	1385·4	1393·7	1402·0	1410·3	1418·6	1427·0	1435·4	1443·8	42
43	1452·2	1460·7	1469·1	1477·6	1486·2	1494·7	1503·3	1511·9	43
44	1520·5	1529·2	1537·9	1546·6	1555·3	1564·0	1572·8	1581·6	44
45	1590·4	1599·3	1608·2	1617·0	1626·0	1634·9	1643·9	1652·9	45
46	1661·9	1670·9	1680·0	1689·1	1698·2	1707·4	1716·5	1725·7	46
47	1734·9	1744·2	1753·5	1762·7	1772·1	1781·4	1790·8	1800·1	47
48	1809·6	1819·0	1828·5	1837·9	1847·5	1857·0	1866·5	1876·1	48
49	1885·7	1895·4	1905·0	1914·7	1924·4	1934·2	1943·9	1953·7	49
50	1963·5	1973·3	1983·2	1993·1	2003·0	2012·9	2022·8	2032·8	50

AREAS OF CIRCLES ADVANCING BY EIGHTHS.

Diam.	0	⅛	¼	⅜	½	⅝	¾	⅞	Diam.
51	2042·8	2052·8	2062·9	2073·0	2083·1	2093·2	2103·3	2113·5	51
52	2123·7	2133·9	2144·2	2154·5	2164·8	2175·1	2185·4	2195·8	52
53	2206·2	2216·6	2227·0	2237·5	2248·0	2258·5	2269·1	2279·6	53
54	2290·2	2300·8	2311·5	2322·1	2332·8	2343·5	2354·3	2365·0	54
55	2375·8	2386·6	2397·5	2408·3	2419·2	2430·1	2441·1	2452·0	55
56	2463·0	2474·0	2485·0	2496·1	2507·2	2518·3	2529·4	2540·6	56
57	2551·8	2563·0	2574·2	2585·4	2596·7	2608·0	2619·4	2630·7	57
58	2642·1	2653·5	2664·9	2676·4	2687·8	2699·3	2710·9	2722·4	58
59	2734·0	2745·6	2757·2	2768·8	2780·5	2792·2	2803·9	2815·7	59
60	2827·4	2839·2	2851·0	2862·9	2874·8	2886·6	2898·6	2910·5	60
61	2922·5	2934·5	2946·5	2958·5	2970·6	2982·7	2994·8	3006·9	61
62	3019·1	3031·3	3043·5	3055·7	3068·0	3080·3	3092·6	3104·9	62
63	3117·2	3129·6	3142·0	3154·5	3166·9	3179·4	3191·9	3204·4	63
64	3217·0	3229·6	3242·2	3254·8	3267·5	3280·1	3292·8	3305·6	64
65	3318·3	3331·1	3343·9	3356·7	3369·6	3382·4	3395·3	3408·2	65
66	3421·2	3434·2	3447·2	3460·2	3473·2	3486·3	3499·4	3512·5	66
67	3525·7	3538·8	3552·0	3565·2	3578·5	3591·7	3605·0	3618·3	67
68	3631·7	3645·0	3658·4	3671·8	3685·3	3698·7	3712·2	3725·7	68
69	3739·3	3752·8	3766·4	3780·0	3793·7	3807·3	3821·0	3834·7	69
70	3848·5	3862·2	3876·0	3889·8	3903·6	3917·5	3931·4	3945·3	70
71	3959·2	3973·1	3987·1	4001·1	4015·2	4029·2	4043·3	4057·4	71
72	4071·5	4085·7	4099·8	4114·0	4128·2	4142·5	4156·8	4171·1	72
73	4185·4	4199·7	4214·1	4228·5	4242·9	4257·4	4271·8	4286·3	73
74	4300·8	4315·4	4329·0	4344·5	4359·2	4373·8	4388·5	4403·2	74
75	4417·9	4432·6	4447·4	4462·2	4477·0	4491·8	4506·7	4521·5	75
76	4536·5	4551·4	4566·4	4581·3	4596·3	4611·4	4626·4	4641·5	76
77	4656·6	4671·8	4686·9	4702·1	4717·3	4732·5	4747·8	4763·1	77
78	4778·4	4793·7	4809·0	4824·4	4839·8	4855·2	4870·7	4886·2	78
79	4901·7	4917·2	4932·7	4948·3	4963·9	4979·5	4995·2	5010·9	79
80	5026·5	5042·3	5058·0	5073·8	5089·6	5105·4	5121·2	5137·1	80
81	5153·0	5168·9	5184·9	5200·8	5216·8	5232·8	5248·9	5264·9	81
82	5281·0	5297·1	5313·3	5329·4	5345·6	5361·8	5378·1	5394·3	82
83	5410·6	5426·9	5443·3	5459·6	5476·0	5492·4	5508·8	5525·3	83
84	5541·8	5558·3	5574·8	5591·4	5607·9	5624·5	5641·2	5657·8	84
85	5674·5	5691·2	5707·9	5724·7	5741·5	5758·3	5775·1	5791·9	85
86	5808·8	5825·7	5842·6	5859·6	5876·5	5893·5	5910·6	5927·6	86
87	5944·7	5961·8	5978·9	5996·0	6013·2	6030·4	6047·6	6064·9	87
88	6082·1	6099·4	6116·7	6134·1	6151·4	6168·8	6186·2	6203·7	88
89	6221·1	6238·6	6256·1	6273·7	6291·2	6308·8	6326·4	6344·1	89
90	6361·7	6379·4	6397·1	6414·9	6432·6	6450·4	6468·2	6486·0	90
91	6503·9	6521·8	6539·7	6557·6	6575·5	6593·5	6611·5	6629·6	91
92	6647·6	6665·7	6683·8	6701·9	6720·1	6738·2	6756·4	6774·7	92
93	6792·9	6811·2	6829·5	6847·8	6866·1	6884·5	6902·9	6921·3	93
94	6939·8	6958·2	6976·7	6995·3	7013·8	7032·4	7051·0	7069·6	94
95	7088·2	7106·9	7125·6	7144·3	7163·0	7181·8	7200·6	7219·4	95
96	7238·2	7257·1	7276·0	7294·9	7313·8	7332·8	7351·8	7370·8	96
97	7389·8	7408·9	7428·0	7447·1	7466·2	7485·3	7504·5	7523·7	97
98	7543·0	7562·2	7581·5	7600·8	7620·1	7639·5	7658·9	7678·3	98
99	7697·7	7717·1	7736·6	7756·1	7775·6	7795·2	7814·8	7834·4	99
100	7854·0	7873·6	7893·3	7913·0	7932·7	7952·5	7972·2	7992·0	100

USE OF THE MATHEMATICAL TABLES

(pages 332 to 353).

LOGARITHMS AND ANTILOGARITHMS

(pages 332 to 335).

The logarithm or "log" of a number consists of an integer and a decimal.

The Integral Part is referred to as the **Index**; and is determined by the following rules:—

Rule (*a*) If the number whose log is required contain one or more integral figures the index is always less by one than the number of integral figures in the number and is always positive.

Rule (*b*) If the number is wholly a decimal the index is numerically greater by one than the number of ciphers after the decimal point and is always negative.

The Decimal Part of a log is called the **Mantissa** and is found from the Tables, pages 332 and 333.

To find the Log of a given number of 4 digits.

Ascertain index by rules (*a*) or (*b*) above.

Rule (*c*) To find mantissa, find the first two digits of the given number in left hand column. Pass along horizontal line and read number in vertical line headed by third digit. Add the number in the same horizontal line in the "Mean Differences" column headed by the fourth digit. The result is the required mantissa which, with the index and decimal point prefixed, is the required log.

Examples—

(1). Required log 4875·0.

There are 4 figures before decimal point .·. index = 3

From log tables, - - - - 487 = ·6875

Difference for 5 = 4

log 4875·0 = 3·6879

(2). Required log ·04875.

There is 1 cipher after decimal point .·. index = $\bar{2}$ (*i.e.* − 2).

From log tables, - - - - 487 = ·6875

Difference for 5 = 4

log ·04875 = $\bar{2}$·6879

LOGS AND ANTILOGS—(*continued*).

Negative Index—Note that the mantissa of a log is always positive, hence the log of a decimal is the algebraic sum of a positive mantissa and a negative index. Thus:—

$$\bar{2}\cdot6879 = \cdot6879 - 2.$$

ANTILOGARITHMS

(pages 334, 335).

Having obtained the log of any expression, to find the number corresponding to this log use the antilog tables in a similar manner to that described above.

NOTE.—In referring to the antilog tables the index of the given log has not to be considered, only the mantissa being used. Having obtained the sequence of figures corresponding to the latter, the index is used to fix the position of the decimal point by the converse of Rules (*a*) and (*b*).

Examples—

(3) Find number corresponding to the log 5·6879.
From antilog tables number = 4875.
Number of figures = (index + 1) = 5 + 1 = 6.
∴ Required number = 487,500.

(4) Find number corresponding to the log $\bar{3}\cdot5503$.
From antilog tables number = 3551.
Number of ciphers = (index − 1) = 3 − 1 = 2.
∴ Required number = ·003551.

TO PERFORM MULTIPLICATION BY USE OF LOGS.

Rule (*d*) Add the logs of the factors.

Example (5)—Required 3·551 × ·04875.

$$\begin{aligned} \log 3\cdot551 &= \cdot5503. \\ \log \cdot04875 &= \bar{2}\cdot6879. \\ \hline \text{Sum} &= \bar{1}\cdot2382. \end{aligned}$$

(Note manipulation of indices).

Product = antilog of sum.
= ·1732.

TO PERFORM DIVISION BY USE OF LOGS.

Rule (*e*) Subtract the log of the divisor from the log of the dividend. The remainder is the log of the quotient.

Example (6)—Required ·3551 ÷ 48·75

$$\begin{aligned} \log \cdot3551 &= \bar{1}\cdot5503 \\ \log 48\cdot75 &= 1\cdot6879 \\ \hline \text{Remainder} &= \bar{3}\cdot8624 \end{aligned}$$

(Note manipulation of negative indices.)

Quotient = antilog of remainder.
= ·007285.

Logs and Antilogs—(*continued*).

To find any power of a number by use of logs.

Rule (*f*) Multiply the log of the number by the exponent of the power to which it is to be raised. This gives the log of the required power.

Example (7)—Required $(3{\cdot}551)^4$

$$\log 3{\cdot}551 = {\cdot}5503.$$
$$\underline{4}$$
$$\text{Product} = 2{\cdot}2012$$
$$\text{Power} = \text{antilog of product}$$
$$= 159{\cdot}0$$

To find any root of a number by use of logs.

Rule (*g*) Divide the log of the number by the exponent of the root which is to be extracted. This gives the log of the required root.

Example (8)—Required $\sqrt[3]{4{\cdot}875}.$

$$\log 4{\cdot}875 = {\cdot}6879$$
$$\text{Quotient} = \frac{{\cdot}6879}{3} = {\cdot}2293$$
$$\text{Root} = \text{antilog of quotient}$$
$$= 1{\cdot}695.$$

Example (9)—Required $\sqrt[5]{{\cdot}004041}.$

$$\log {\cdot}004041 = \bar{3}{\cdot}6065.$$
$$= {\cdot}6065 - 3.$$ (Note manipulation of indices).
$$= 2{\cdot}6065 - 5.$$
$$\frac{2{\cdot}6065 - 5}{5} = {\cdot}5213 - 1.$$
$$\text{Quotient} = \bar{1}{\cdot}5213.$$
$$\text{Root} = \text{antilog of quotient.}$$
$$= {\cdot}3321.$$

Mathematical Tables—(*continued*).

TRIGONOMETRICAL TABLES

(pages 336 to 347).

The tables of sines, cosines, &c., give the required function for any angle less than 90°.

The method of using the tables is similar to that described for logs.

In the **sine** and **cosine** tables the decimal point is not shown, as all values are less than unity.

Care must be taken that in using the **cosine, cosecant,** and **cotangent** tables for an angle containing an odd number of minutes, **the mean difference be subtracted,** not added as in the other tables.

In the **tangent, cotangent, cosecant,** and **secant tables,** the decimal point is shown in the first column only, except in the cases where the variation of the function is so rapid that an approximate value only can be given. The integer (if any) is also given in the first column. The latter is to be prefixed to all values in the corresponding horizontal line with the following exception:—

Rule (*h*) Where values in any of the horizontal lines are printed in *italics* the integer to be prefixed is—

(*a*) When differences have to be added, greater by one than the number in the left hand column corresponding.

(*b*) When the differences have to be subtracted, less by one than the number in the left hand column corresponding.

Example (10)—Required tan 63° 25′

From tables tan 63° 24′ = 1·9970

Difference for 1′ = 15

tan 63° 25′ = 1·9985

Example (11)—Required tan 63° 32′.

In the tables opposite 63° and under 30′ read *0057*.

Corresponding integer in first column is 1.

∴ tan 63° 30′ = 2·0057

Difference for 2′ = 29

tan 63° 32′ = 2·0086

Note that the addition or subtraction of the difference for odd minutes occasionally causes the alteration of the corresponding integer as in example (12).

Example (12)—Required tan 63° 27′

From tables, tan 63° 24′ = 1·9970

Difference for 3′ = 44

∴ tan 63° 27′ = 2·0014

Mathematical Tables—*(concluded)*.

SQUARES AND SQUARE ROOTS

(pages 348 to 353).

The Tables of Squares afford a rapid means of finding approximately the square of any number from 1 to 9999.

The tables are used as previously described for logs. The position of the decimal point is fixed by a rough mental calculation.

Example (13)—Required $(98{\cdot}3)^2$.

Opposite 9·8 and under 3 read 96·63.

Now $98{\cdot}3 = 10 \times 9{\cdot}83$. $\therefore (98{\cdot}3)^2 = 10^2(9{\cdot}83)^2 = 100 \times 96{\cdot}63$
$= 9663$.

Tables of Square Roots. It will be noticed that two tables of square roots are given.

Rule (*i*) TABLE 100 to 999·9 (pages 350, 351) will be used:—

(*a*) for the square root of a number greater than unity if the number of digits before the decimal point is odd;

(*b*) for the square root of a number less than unity if the number of ciphers after the decimal point is odd.

Rule (*k*) TABLE 1000 to 9999 (pages 352, 353) will be used:—

(*c*) for the square root of a number greater than unity if the number of digits before the decimal point is even;

(*d*) for the square root of a number less than unity if the number of ciphers after the decimal point is zero or even.

A rough mental calculation will enable the position of the decimal point in the square to be fixed.

Examples—

(14) Required $\sqrt{983{\cdot}1}$

There are 3 digits before point, ∴ Table 100 to 999·9 is used.
Square Root = 31·35.

(15) Required $\sqrt{{\cdot}09831}$

There is one cipher after point, ∴ same Table is used.
Square Root = ·3135.

(16) Required $\sqrt{98{\cdot}31}$

There are 2 digits before point, ∴ Table 1000 to 9999 is used.
Square Root = 9·915.

(17) Required $\sqrt{{\cdot}9831}$

There are no ciphers after point, ∴ same Table is used.
Square Root = ·9915.

DECIMALS OF AN INCH FOR EACH 1/64th.

1/32nds.	1/64ths.	Decimal.	Fraction.	1/32nds.	1/64ths.	Decimal.	Fraction.
	1	·015625			33	·515625	
1	2	·03125		17	34	·53125	
	3	·046875			35	·546875	
2	4	·0625	1—16	18	36	·5625	9—16
	5	·078125			37	·578125	
3	6	·09375		19	38	·59375	
	7	·109375			39	·609375	
4	8	·125	1—8	20	40	·625	5—8
	9	·140625			41	·640625	
5	10	·15625		21	42	·65625	
	11	·171875			43	·671875	
6	12	·1875	3—16	22	44	·6875	11—16
	13	·203125			45	·703125	
7	14	·21875		23	46	·71875	
	15	·234375			47	·734375	
8	16	·25	1—4	24	48	·75	3—4
	17	·265625			49	·765625	
9	18	·28125		25	50	·78125	
	19	·296875			51	·796875	
10	20	·3125	5—16	26	52	·8125	13—16
	21	·328125			53	·828125	
11	22	·34375		27	54	·84375	
	23	·359375			55	·859375	
12	24	·375	3—8	28	56	·875	7—8
	25	·390625			57	·890625	
13	26	·40625		29	58	·90625	
	27	·421875			59	·921875	
14	28	·4375	7—16	30	60	·9375	15—16
	29	·453125			61	·953125	
15	30	·46875		31	62	·96875	
	31	·484375			63	·984375	
16	32	·5	1—2	32	64	1·	1

DECIMALS OF A FOOT.

For each 1/64th of an inch.

Inch.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
0		·0833	·1667	·2500	·3333	·4167	·5000	·5833	·6667	·7500	·8333	·9167
1/64	·0013	·0846	·1680	·2513	·3346	·4180	·5013	·5846	·6680	·7513	·8346	·9180
1/32	·0026	·0859	·1693	·2526	·3359	·4193	·5026	·5859	·6693	·7526	·8359	·9193
3/64	·0039	·0872	·1706	·2539	·3372	·4206	·5039	·5872	·6706	·7539	·8372	·9206
1/16	·0052	·0885	·1719	·2552	·3385	·4219	·5052	·5885	·6719	·7552	·8385	·9219
5/64	·0065	·0898	·1732	·2565	·3398	·4232	·5065	·5898	·6732	·7565	·8398	·9232
3/32	·0078	·0911	·1745	·2578	·3411	·4245	·5078	·5911	·6745	·7578	·8411	·9245
7/64	·0091	·0924	·1758	·2591	·3424	·4258	·5091	·5924	·6758	·7591	·8424	·9258
1/8	·0104	·0937	·1771	·2004	·3437	·4271	·5104	·5937	·6771	·7604	·8437	·9271
9/64	·0117	·0951	·1784	·2617	·3451	·4284	·5117	·5951	·6784	·7617	·8451	·9284
5/32	·0130	·0964	·1797	·2630	·3464	·4297	·5130	·5964	·6797	·7630	·8464	·9297
11/64	·0143	·0977	·1810	·2043	·3477	·4310	·5143	·5977	·6810	·7643	·8477	·9310
3/16	·0156	·0990	·1823	·2656	·3490	·4323	·5156	·5990	·6823	·7656	·8490	·9323
13/64	·0169	·1003	·1836	·2669	·3503	·4336	·5169	·6003	·6836	·7669	·8503	·9336
7/32	·0182	·1016	·1849	·2682	·3516	·4349	·5182	·6016	·6849	·7682	·8516	·9349
15/64	·0195	·1029	·1862	·2695	·3529	·4362	·5195	·6029	·6862	·7695	·8529	·9362
1/4	·0208	·1042	·1875	·2708	·3542	·4375	·5208	·6042	·6875	·7708	·8542	·9375
17/64	·0221	·1055	·1888	·2721	·3555	·4388	·5221	·6055	·6888	·7721	·8555	·9388
9/32	·0234	·1068	·1901	·2734	·3568	·4401	·5234	·6068	·6901	·7734	·8568	·9401
19/64	·0247	·1081	·1914	·2747	·3581	·4414	·5247	·6081	·6914	·7747	·8581	·9414
5/16	·0260	·1094	·1927	·2760	·3594	·4427	·5260	·6094	·6927	·7760	·8594	·9427
21/64	·0273	·1107	·1940	·2773	·3607	·4440	·5273	·6107	·6940	·7773	·8607	·9440
11/32	·0286	·1120	·1953	·2786	·3620	·4453	·5286	·6120	·6953	·7786	·8620	·9453
23/64	·0299	·1133	·1966	·2799	·3633	·4466	·5299	·6133	·6966	·7799	·8633	·9466
3/8	·0312	·1146	·1979	·2812	·3646	·4479	·5312	·6146	·6979	·7812	·8646	·9479
25/64	·0326	·1159	·1992	·2826	·3659	·4492	·5326	·6159	·6992	·7826	·8659	·9492
13/32	·0339	·1172	·2005	·2839	·3672	·4505	·5339	·6172	·7005	·7839	·8672	·9505
27/64	·0352	·1185	·2018	·2852	·3685	·4518	·5352	·6185	·7018	·7852	·8685	·9518
7/16	·0365	·1198	·2031	·2865	·3698	·4531	·5365	·6198	·7031	·7865	·8698	·9531
29/64	·0378	·1211	·2044	·2878	·3711	·4544	·5378	·6211	·7044	·7878	·8711	·9544
15/32	·0391	·1224	·2057	·2891	·3724	·4557	·5391	·6224	·7057	·7891	·8724	·9557
31/64	·0404	·1237	·2070	·2904	·3737	·4570	·5404	·6237	·7070	·7904	·8737	·9570
1/2	·0417	·1250	·2083	·2917	·3750	·4583	·5417	·6250	·7083	·7917	·8750	·9583

DECIMALS OF A FOOT.

For each 1/64th of an inch.

Inch.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
33/64	·0430	·1263	·2096	·2930	·3763	·4596	·5430	·6263	·7096	·7930	·8763	·9596
17/32	·0443	·1276	·2109	·2943	·3776	·4609	·5443	·6276	·7109	·7943	·8776	·9609
35/64	·0456	·1289	·2122	·2956	·3789	·4622	·5456	·6289	·7122	·7956	·8789	·9622
9/16	·0469	·1302	·2135	·2969	·3802	·4635	·5469	·6302	·7135	·7969	·8802	·9635
37/64	·0482	·1315	·2148	·2982	·3815	·4648	·5482	·6315	·7148	·7982	·8815	·9648
19/32	·0495	·1328	·2161	·2995	·3828	·4661	·5495	·6328	·7161	·7995	·8828	·9661
39/64	·0508	·1341	·2174	·3008	·3841	·4674	·5508	·6341	·7174	·8008	·8841	·9674
5/8	·0521	·1354	·2188	·3021	·3854	·4688	·5521	·6354	·7188	·8021	·8854	·9688
41/64	·0534	·1367	·2201	·3034	·3867	·4701	·5534	·6367	·7201	·8034	·8867	·9701
21/32	·0547	·1380	·2214	·3047	·3880	·4714	·5547	·6380	·7214	·8047	·8880	·9714
43/64	·0560	·1393	·2227	·3060	·3893	·4727	·5560	·6393	·7227	·8060	·8893	·9727
11/16	·0573	·1406	·2240	·3073	·3906	·4740	·5573	·6406	·7240	·8073	·8906	·9740
45/64	·0586	·1419	·2253	·3086	·3919	·4753	·5586	·6419	·7253	·8086	·8919	·9753
23/32	·0599	·1432	·2266	·3099	·3932	·4766	·5599	·6432	·7266	·8099	·8932	·9766
47/64	·0612	·1445	·2279	·3112	·3945	·4779	·5612	·6445	·7279	·8112	·8945	·9779
3/4	·0625	·1458	·2292	·3125	·3958	·4792	·5625	·6458	·7292	·8125	·8958	·9792
49/64	·0638	·1471	·2305	·3138	·3971	·4805	·5638	·6471	·7305	·8138	·8971	·9805
25/32	·0651	·1484	·2318	·3151	·3984	·4818	·5651	·6484	·7318	·8151	·8984	·9818
51/64	·0664	·1497	·2331	·3164	·3997	·4831	·5664	·6497	·7331	·8164	·8997	·9831
13/16	·0677	·1510	·2344	·3177	·4010	·4844	·5677	·6510	·7344	·8177	·9010	·9844
53/64	·0690	·1523	·2357	·3190	·4023	·4857	·5690	·6523	·7357	·8190	·9023	·9857
27/32	·0703	·1536	·2370	·3203	·4036	·4870	·5703	·6536	·7370	·8203	·9036	·9870
55/64	·0716	·1549	·2383	·3216	·4049	·4883	·5716	·6549	·7383	·8216	·9049	·9883
7/8	·0729	·1562	·2396	·3229	·4062	·4896	·5729	·6562	·7396	·8229	·9062	·9896
57/64	·0742	·1576	·2409	·3242	·4076	·4909	·5742	·6576	·7409	·8242	·9076	·9909
29/32	·0755	·1589	·2422	·3255	·4089	·4922	·5755	·6589	·7422	·8255	·9089	·9922
59/64	·0768	·1602	·2435	·3268	·4102	·4935	·5768	·6602	·7435	·8268	·9102	·9935
15/16	·0781	·1615	·2448	·3281	·4115	·4948	·5781	·6615	·7448	·8281	·9115	·9948
61/64	·0794	·1628	·2461	·3294	·4128	·4961	·5794	·6628	·7461	·8294	·9128	·9961
31/32	·0807	·1641	·2474	·3307	·4141	·4974	·5807	·6641	·7474	·8307	·9141	·9974
63/64	·0820	·1654	·2487	·3320	·4154	·4987	·5820	·6654	·7487	·8320	·9154	·9987
1												1·0000

BRITISH WEIGHTS AND MEASURES WITH METRICAL EQUIVALENTS.

LINEAR MEASURE.

Mile.	Furlongs.	Poles.	Yards.	Feet.	Inches.	Metrical Equivalents.
1	8	320	1760	5280	63,360	1609·31 *m*
	1	40	220	660	7,920	201·16 *m*
		1	5·5	16·5	198	5·03 *m*
			1	3	36	91·44 *cm*
				1	12	30·48 *cm*
					1	2·54 *cm*

SURVEYING MEASURE (Linear).

Mile.	Furlongs.	Chains.	Poles.	Yards.	Feet.	Links.	Metrical Equivalents.
1	8	80	320	1760	5280	8000	1609·31 *m*
	1	10	40	220	660	1000	201·16 *m*
		1	4	22	66	100	20·12 *m*
			1	5·5	16·5	25	5·03 *m*
				1	3	4·54	91·44 *cm*
					1	1·51	30·48 *cm*
						1	20·12 *cm*

SQUARE MEASURE.

Square Mile.	Acres.	Square Chains.	Sq. Poles or Perches.	Square Yards.	Square Feet.	Square Links.	Metrical Equivalents.
1	640	6400	102,400	3,097,600	—	—	258·99 *ha*
	1	10	160	4,840	43,560	100,000	4046·71 m^2
		1	16	484	4,356	10,000	404·67 m^2
			1	30·25	272·25	625	25·29 m^2
				1	9	20·7	·836 m^2
					1	2·3	928·99 cm^2
						1	404·67 cm^2

METRIC UNITS AND BRITISH EQUIVALENTS.

METRIC ABBREVIATIONS.

Linear Measure.	Square Measure.	Cubic Measure.	Measure of Capacity.	Weight.
km=kilometre	km^2=sq. kilometre	m^3=cub. metre	*kl*=kilolitre	*kgm*=kilogramme
m=metre	*ha* =hectare	dm^3= ,, decimetre	*hl*=hectolitre	*gm*=gramme
dm=decimetre	*a* =are	cm^3= ,, centimetre	*l*=litre	*dgm*=decigramme
cm=centimetre	m^2=sq. metre	mm^3= ,, millimetre	*dl*=decilitre	*cgm*=centigramme
mm=millimetre	dm^2= ,, decimetre		*cl*=centilitre	*mgm*=milligramme
	cm^2= ,, centimetre			
	mm^2= ,, millimetre			

LINEAR MEASURE.

Kilometres.	Metres.	Decimetres.	Centimetres.	Millimetres.	British Equivalents.
1	1000	10,000	100,000	1,000,000	·6214 mile
	1	10	100	1,000	3·281 feet
		1	10	100	·3281 foot
			1	10	·3937 inch
				1	·03937 inch

SQUARE MEASURE.

Square Kilometres.	Hectares.	Ares.	Square Metres.	Square Decimetres.	Square Centimetres.	Square Millimetres.	British Equivalents.
1	100	10,000	1,000,000	—	—	—	·3861 sq. mile
	1	100	10,000	1,000,000	—	—	·00386 ,, mile
		1	100	10,000	1,000,000	—	1076 ,, feet
			1	100	10,000	1,000,000	10·76 ,, feet
				1	100	10,000	·1076 ,, feet
					1	100	·1550 ,, inch
						1	·00155 ,, inch

BRITISH WEIGHTS AND MEASURES WITH METRICAL EQUIVALENTS.

CUBIC MEASURES.

Cubic Yard.	Cubic Feet.	Cubic Inches.	Metrical Equivalent.
1	27	46,656	·764 m^3
	1	1,728	·029 m^3
		1	16·386 cm^3

CAPACITY.

Quarter.	Bushels.	Pecks.	Gallons.	Quarts.	Pints.	Cubic Inches.	Metrical Equivalent.
1	8	32	64	256	512	17,757·6	290·781 *l*
	1	4	8	32	64	2,219·7	36·348 *l*
		1	2	8	16	554·9	9·087 *l*
			1	4	8	277·5	4·543 *l*
				1	2	69·4	1·136 *l*
					1	34·7	·568 *l*
						1	16·386 *ml*

AVOIRDUPOIS WEIGHT.

Ton.	Cwts.	Qrs.	Stones.	Lbs.	Ounces.	Drams.	Metrical Equivalent.
1	20	80	160	2,240	35,840	573,440	1,016·048 *kgm*
	1	4	8	112	1,792	28,672	50·802 *kgm*
		1	2	28	448	7,168	12·700 *kgm*
			1	14	224	3,584	6·350 *kgm*
				1	16	256	453·59 *gm*
					1	16	28·35 *gm*
						1	1·77 *gm*

METRIC UNITS AND BRITISH EQUIVALENTS.

Significance of Prefixes.

kilo	= 1000	**deci**	= ·1
hecto	= 100	**centi**	= ·01
deka	= 10	**milli**	= ·001

CUBIC MEASURE.

1 cubic metre = 1,000,000 *cm*^{3} = 35·32 cub. feet.

1 cubic centimetre = 0 06103 cub. inches.

CAPACITY.

1 litre = 1000 *cm*^{3} = 0·03532 cub. feet.

„ = 0·2201 gallons.

1 litre of water = 1 *kg* = 2·205 lbs.

WEIGHT.

1 Tonne = 1000 *kg* = 0·9843 ton.

1 Kilogramme = 1000 *gms* = 2·205 lbs.

1 gramme = 0·03527 oz.

EQUIVALENTS OF MOMENTS OF INERTIA AND SECTION MODULI.

Moment of Inertia in inch units = ·02403 × Moment of Inertia in *cm* units.

„ „ „ „ *cm* units = 41·6198 × „ „ „ „ inch units.

Modulus of Section in inch units = ·06103 × Modulus of Section in *cm* units.

„ „ „ „ *cm* units = 16·3860 × „ „ „ „ inch units.

EQUIVALENTS OF FEET AND INCHES IN MILLIMETRES.

Feet.	0″	1″	2″	3″	4″	5″
0		25·4	50·8	76·2	102	127
1	305	330	356	381	406	432
2	610	635	660	686	711	737
3	914	940	965	991	1016	1041
4	1219	1245	1270	1295	1321	1346
5	1524	1549	1575	1600	1626	1651
6	1829	1854	1880	1905	1930	1956
7	2134	2159	2184	2210	2235	2261
8	2438	2464	2489	2515	2540	2565
9	2743	2769	2794	2819	2845	2870
10	3048	3073	3099	3124	3150	3175
11	3353	3378	3404	3429	3454	3480
12	3658	3683	3708	3734	3759	3785
13	3962	3988	4013	4039	4064	4089
14	4267	4293	4318	4343	4369	4394
15	4572	4597	4623	4648	4674	4699
16	4877	4902	4928	4953	4978	5004
17	5182	5207	5232	5258	5283	5309
18	5486	5512	5537	5563	5588	5613
19	5791	5817	5842	5867	5893	5918
20	6096	6121	6147	6172	6198	6223
21	6401	6426	6452	6477	6502	6528
22	6706	6731	6756	6782	6807	6833
23	7010	7036	7061	7087	7112	7137
24	7315	7341	7366	7391	7417	7442
25	7620	7645	7671	7696	7722	7747
26	7925	7950	7975	8001	8026	8052
27	8230	8255	8280	8306	8331	8357
28	8534	8559	8585	8610	8636	8661
29	8839	8864	8890	8915	8941	8966
30	9144	9169	9195	9220	9246	9271
31	9449	9474	9500	9525	9551	9576
32	9753	9778	9804	9829	9855	9880
33	10058	10083	10109	10134	10160	10185
34	10363	10388	10414	10439	10465	10490
35	10668	10693	10719	10744	10770	10795
36	10973	10998	11024	11049	11074	11100
37	11277	11302	11328	11353	11379	11404
38	11582	11607	11633	11658	11684	11709
39	11887	11912	11938	11963	11989	12014

40 feet = 12192 millimetres.

EQUIVALENTS OF FEET AND INCHES IN MILLIMETRES.

6″	7″	8″	9″	10″	11″	Feet.
152	178	203	229	254	279	0
457	483	508	533	559	584	1
762	787	813	838	864	889	2
1067	1092	1118	1143	1168	1194	3
1372	1397	1422	1448	1473	1499	4
1676	1702	1727	1753	1778	1803	5
1981	2007	2032	2057	2083	2108	6
2286	2311	2337	2362	2388	2413	7
2591	2616	2642	2667	2692	2718	8
2896	2921	2946	2972	2997	3023	9
3200	3226	3251	3277	3302	3327	10
3505	3531	3556	3581	3607	3632	11
3810	3835	3861	3886	3912	3937	12
4115	4140	4166	4191	4216	4242	13
4420	4445	4470	4496	4521	4547	14
4724	4750	4775	4801	4826	4851	15
5029	5055	5080	5105	5131	5156	16
5334	5359	5385	5410	5436	5461	17
5639	5664	5690	5715	5740	5766	18
5944	5969	5994	6020	6045	6071	19
6248	6274	6299	6325	6350	6375	20
6553	6579	6604	6629	6655	6680	21
6858	6883	6909	6934	6960	6985	22
7163	7188	7214	7239	7264	7290	23
7467	7493	7518	7545	7569	7594	24
7772	7798	7823	7849	7874	7899	25
8077	8102	8128	8153	8179	8204	26
8382	8407	8433	8458	8484	8509	27
8686	8712	8737	8763	8788	8814	28
8991	9017	9042	9068	9093	9118	29
9296	9322	9347	9373	9398	9423	30
9601	9627	9652	9677	9703	9728	31
9905	9931	9956	9982	10007	10032	32
10210	10236	10261	10287	10312	10337	33
10515	10541	10566	10592	10617	10642	34
10820	10846	10871	10896	10922	10947	35
11125	11151	11176	11201	11227	11252	36
11429	11455	11480	11506	11531	11556	37
11734	11760	11785	11811	11836	11861	38
12039	12065	12090	12116	12141	12166	39

40 feet = 12192 millimetres.

EQUIVALENTS OF INCHES IN MILLIMETRES.

Rising by 32nds of an inch to 13 inches.

Inches.	0	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{5}{32}$	$\frac{3}{16}$	$\frac{7}{32}$
0		·794	1·587	2·381	3·175	3·969	4·762	5·556
1	25·400	26·193	26·987	27·781	28·574	29·368	30·162	30·956
2	50·799	51·593	52·387	53·180	53·974	54·768	55·561	56·355
3	76·199	76·992	77·786	78·580	79·374	80·167	80·961	81·755
4	101·60	102·39	103·19	103·98	104·77	105·57	106·36	107·15
5	127·00	127·79	128·59	129·38	130·17	130·97	131·76	132·55
6	152·40	153·19	153·98	154·78	155·57	156·37	157·16	157·95
7	177·80	178·59	179·38	180·18	180·97	181·76	182·56	183·35
8	203·20	203·99	204·78	205·58	206·37	207·16	207·96	208·75
9	228·60	229·39	230·18	230·98	231·77	232·56	233·36	234·15
10	254·00	254·79	255·58	256·38	257·17	257·96	258·76	259·55
11	279·39	280·19	280·98	281·78	282·57	283·36	284·16	284·95
12	304·79	305·59	306·38	307·18	307·97	308·76	309·56	310·35

Inches.	$\frac{1}{2}$	$\frac{17}{32}$	$\frac{9}{16}$	$\frac{19}{32}$	$\frac{5}{8}$	$\frac{21}{32}$	$\frac{11}{16}$	$\frac{23}{32}$
0	12·700	13·494	14·287	15·081	15·875	16·668	17·462	18·256
1	38·099	38·893	39·687	40·481	41·274	42·068	42·862	43·655
2	63·499	64·293	65·086	65·880	66·674	67·468	68·261	69·055
3	88·898	89·692	90·486	91·280	92·073	92·867	93·661	94·455
4	114·30	115·09	115·89	116·68	117·47	118·27	119·06	119·85
5	139·70	140·49	141·28	142·08	142·87	143·67	144·46	145·25
6	165·10	165·89	166·68	167·48	168·27	169·07	169·86	170·65
7	190·50	191·29	192·08	192·88	193·67	194·47	195·26	196·05
8	215·90	216·69	217·48	218·28	219·07	219·87	220·66	221·45
9	241·30	242·09	242·88	243·68	244·47	245·26	246·06	246·85
10	266·70	267·49	268·28	269·08	269·87	270·66	271·46	272·25
11	292·10	292·89	293·68	294·48	295·27	296·06	296·86	297·65
12	317·49	318·29	319·08	319·88	320·67	321·46	322·26	323·05

13 inches = 330·19 millimetres.

EQUIVALENTS OF INCHES IN MILLIMETRES.

Rising by 32nds of an inch to 13 inches.

$\frac{1}{4}$	$\frac{9}{32}$	$\frac{5}{16}$	$\frac{11}{32}$	$\frac{3}{8}$	$\frac{13}{32}$	$\frac{7}{16}$	$\frac{15}{32}$	Inches.
6·350	7·144	7·937	8·731	9·525	10·319	11·112	11·906	0
31·749	32·543	33·337	34·131	34·924	35·718	36·512	37·306	1
57·149	57·943	58·736	59·530	60·324	61·118	61·911	62·705	2
82·549	83·342	84·136	84·930	85·723	86·517	87·311	88·105	3
107·95	108·74	109·54	110·33	111·12	111·92	112·71	113·50	4
133·35	134·14	134·94	135·73	136·52	137·32	138·11	138·90	5
158·75	159·54	160·33	161·13	161·92	162·72	163·51	164·30	6
184·15	184·94	185·73	186·53	187·32	188·11	188·91	189·70	7
209·55	210·34	211·13	211·93	212·72	213·51	214·31	215·10	8
234·95	235·74	236·53	237·33	238·12	238·91	239·71	240·50	9
260·35	261·14	261·93	262·73	263·52	264·31	265·11	265·90	10
285·74	286·54	287·33	288·13	288·92	289·71	290·51	291·30	11
311·14	311·94	312·73	313·53	314·32	315·11	315·91	316·70	12

$\frac{3}{4}$	$\frac{25}{32}$	$\frac{13}{16}$	$\frac{27}{32}$	$\frac{7}{8}$	$\frac{29}{32}$	$\frac{15}{16}$	$\frac{31}{32}$	Inches.
19·050	19·843	20·637	21·431	22·225	23·018	23·812	24·606	0
44·449	45·243	46·037	46·830	47·624	48·418	49·212	50·005	1
69·849	70·642	71·436	72·230	73·024	73·817	74·611	75·405	2
95·248	96·042	96·836	97·629	98·423	99·217	100·01	100·80	3
120·65	121·44	122·24	123·03	123·82	124·62	125·41	126·20	4
146·05	146·84	147·63	148·43	149·22	150·02	150·81	151·60	5
171·45	172·24	173·03	173·83	174·62	175·42	176·21	177·00	6
196·85	197·64	198·43	199·23	200·02	200·82	201·61	202·40	7
222·25	223·04	223·83	224·63	225·42	226·21	227·01	227·80	8
247·65	248·44	249·23	250·03	250·82	251·61	252·41	253·20	9
273·05	273·84	274·63	275·43	276·22	277·01	277·81	278·60	10
298·44	299·24	300·03	300·83	301·62	302·41	303·21	304·00	11
323·84	324·64	325·43	326·23	327·02	327·81	328·61	329·40	12

13 inches = 330·19 millimetres.

EQUIVALENTS OF MILLIMETRES IN INCHES.

Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.
1	·039	51	2·008	101	3·976	151	5·945	201	7·913
2	·079	52	2·047	102	4·016	152	5·984	202	7·953
3	·118	53	2·087	103	4·055	153	6·024	203	7·992
4	·157	54	2·126	104	4·095	154	6·063	204	8·032
5	·197	55	2·165	105	4·134	155	6·102	205	8·071
6	·236	56	2·205	106	4·173	156	6·142	206	8·110
7	·276	57	2·244	107	4·213	157	6·181	207	8·150
8	·315	58	2·283	108	4·252	158	6·221	208	8·189
9	·354	59	2·323	109	4·291	159	6·260	209	8·228
10	·394	60	2·362	110	4·331	160	6·299	210	8·268
11	·433	61	2·402	111	4·370	161	6·339	211	8·307
12	·472	62	2·441	112	4·409	162	6·378	212	8·347
13	·512	63	2·480	113	4·449	163	6·417	213	8·386
14	·551	64	2·520	114	4·488	164	6·457	214	8·425
15	·591	65	2·559	115	4·528	165	6·496	215	8·465
16	·630	66	2·598	116	4·567	166	6·535	216	8·504
17	·669	67	2·638	117	4·606	167	6·575	217	8·543
18	·709	68	2·677	118	4·646	168	6·614	218	8·583
19	·748	69	2·717	119	4·685	169	6·654	219	8·622
20	·787	70	2·756	120	4·724	170	6·693	220	8·661
21	·827	71	2·795	121	4·764	171	6·732	221	8·701
22	·866	72	2·835	122	4·803	172	6·772	222	8·740
23	·906	73	2·874	123	4·843	173	6·811	223	8·780
24	·945	74	2·913	124	4·882	174	6·850	224	8·819
25	·984	75	2·953	125	4·921	175	6·890	225	8·858
26	1·024	76	2·992	126	4·961	176	6·929	226	8·898
27	1·063	77	3·032	127	5·000	177	6·969	227	8·937
28	1·102	78	3·071	128	5·039	178	7·008	228	8·976
29	1·142	79	3·110	129	5·079	179	7·047	229	9·016
30	1·181	80	3·150	130	5·118	180	7·087	230	9·055
31	1·220	81	3·189	131	5·158	181	7·126	231	9·095
32	1·260	82	3·228	132	5·197	182	7·165	232	9·134
33	1·299	83	3·268	133	5·236	183	7·205	233	9·173
34	1·339	84	3·307	134	5·276	184	7·244	234	9·213
35	1·378	85	3·346	135	5·315	185	7·284	235	9·252
36	1·417	86	3·386	136	5·354	186	7·323	236	9·291
37	1·457	87	3·425	137	5·394	187	7·362	237	9·331
38	1·496	88	3·465	138	5·433	188	7·402	238	9·370
39	1·535	89	3·504	139	5·472	189	7·441	239	9·410
40	1·575	90	3·543	140	5·512	190	7·480	240	9·449
41	1·614	91	3·583	141	5·551	191	7·520	241	9·488
42	1·654	92	3·622	142	5·591	192	7·559	242	9·528
43	1·693	93	3·661	143	5·630	193	7·598	243	9·567
44	1·732	94	3·701	144	5·669	194	7·638	244	9·606
45	1·772	95	3·740	145	5·709	195	7·677	245	9·646
46	1·811	96	3·780	146	5·748	196	7·717	246	9·685
47	1·850	97	3·819	147	5·787	197	7·756	247	9·724
48	1·890	98	3·858	148	5·827	198	7·795	248	9·764
49	1·929	99	3·898	149	5·866	199	7·835	249	9·803
50	1·969	100	3·937	150	5·906	200	7·874	250	9·843

EQUIVALENTS OF MILLIMETRES IN INCHES.

Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.
251	9·882	301	11·850	351	13·819	401	15·788	451	17·756
252	9·921	302	11·890	352	13·858	402	15·827	452	17·795
253	9·961	303	11·929	353	13·898	403	15·866	453	17·835
254	10·000	304	11·969	354	13·937	404	15·906	454	17·874
255	10·039	305	12·008	355	13·977	405	15·945	455	17·914
256	10·079	306	12·047	356	14·016	406	15·984	456	17·953
257	10·118	307	12·087	357	14·055	407	16·024	457	17·992
258	10·158	308	12·126	358	14·095	408	16·063	458	18·032
259	10·197	309	12·165	359	14·134	409	16·103	459	18·071
260	10·236	310	12·205	360	14·173	410	16·142	460	18·110
261	10·276	311	12·244	361	14·213	411	16·181	461	18·150
262	10·315	312	12·284	362	14·252	412	16·221	462	18·189
263	10·354	313	12·323	363	14·291	413	16·260	463	18·229
264	10·394	314	12·362	364	14·331	414	16·299	464	18·268
265	10·433	315	12·402	365	14·370	415	16·339	465	18·307
266	10·473	316	12·441	366	14·410	416	16·378	466	18·347
267	10·512	317	12·480	367	14·449	417	16·417	467	18·386
268	10·551	318	12·520	368	14·488	418	16·457	468	18·425
269	10·591	319	12·559	369	14·528	419	16·496	469	18·465
270	10·630	320	12·599	370	14·567	420	16·536	470	18·504
271	10·669	321	12·638	371	14·606	421	16·575	471	18·543
272	10·709	322	12·677	372	14·646	422	16·614	472	18·583
273	10·748	323	12·717	373	14·685	423	16·654	473	18·622
274	10·787	324	12·756	374	14·725	424	16·693	474	18·662
275	10·827	325	12·795	375	14·764	425	16·732	475	18·701
276	10·866	326	12·835	376	14·803	426	16·772	476	18·740
277	10·906	327	12·874	377	14·843	427	16·811	477	18·780
278	10·945	328	12·913	378	14·882	428	16·851	478	18·819
279	10·984	329	12·953	379	14·921	429	16·890	479	18·858
280	11·024	330	12·992	380	14·961	430	16·929	480	18·898
281	11·063	331	13·032	381	15·000	431	16·969	481	18·937
282	11·102	332	13·071	382	15·040	432	17·008	482	18·977
283	11·142	333	13·110	383	15·079	433	17·047	483	19·016
284	11·181	334	13·150	384	15·118	434	17·087	484	19·055
285	11·221	335	13·189	385	15·158	435	17·126	485	19·095
286	11·260	336	13·228	386	15·197	436	17·166	486	19·134
287	11·299	337	13·268	387	15·236	437	17·205	487	19·173
288	11·339	338	13·307	388	15·276	438	17·244	488	19·213
289	11·378	339	13·347	389	15·315	439	17·284	489	19·252
290	11·417	340	13·386	390	15·354	440	17·323	490	19·292
291	11·457	341	13·425	391	15·394	441	17·362	491	19·331
292	11·496	342	13·465	392	15·433	442	17·402	492	19·370
293	11·536	343	13·504	393	15·473	443	17·441	493	19·410
294	11·575	344	13·543	394	15·512	444	17·480	494	19·449
295	11·614	345	13·583	395	15·551	445	17·520	495	19·488
296	11·654	346	13·622	396	15·591	446	17·559	496	19·528
297	11·693	347	13·662	397	15·630	447	17·599	497	19·567
298	11·732	348	13·701	398	15·669	448	17·638	498	19·606
299	11·772	349	13·740	399	15·709	449	17·677	499	19·646
300	11·811	350	13·780	400	15·748	450	17·717	500	19·685

EQUIVALENTS OF MILLIMETRES IN INCHES.

Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.
501	19·725	551	21·693	601	23·662	651	25·630	701	27·599
502	19·764	552	21·732	602	23·701	652	25·670	702	27·638
503	19·803	553	21·772	603	23·740	653	25·709	703	27·677
504	19·843	554	21·811	604	23·780	654	25·748	704	27·717
505	19·882	555	21·851	605	23·819	655	25·788	705	27·756
506	19·921	556	21·890	606	23·858	656	25·827	706	27·796
507	19·961	557	21·929	607	23·898	657	25·866	707	27·835
508	20·000	558	21·969	608	23·937	658	25·906	708	27·874
509	20·040	559	22·008	609	23·977	659	25·945	709	27·914
510	20·079	560	22·047	610	24·016	660	25·984	710	27·953
511	20·118	561	22·087	611	24·055	661	26·024	711	27·992
512	20·158	562	22·126	612	24·095	662	26·063	712	28·032
513	20·197	563	22·166	613	24·134	663	26·103	713	28·071
514	20·236	564	22·205	614	24·173	664	26·142	714	28·110
515	20·276	565	22·244	615	24·213	665	26·181	715	28·150
516	20·315	566	22·284	616	24·252	666	26·221	716	28·189
517	20·355	567	22·323	617	24·292	667	26·260	717	28·229
518	20·394	568	22·362	618	24·331	668	26·299	718	28·268
519	20·433	569	22·402	619	24·370	669	26·339	719	28·307
520	20·473	570	22·441	620	24·410	670	26·378	720	28·347
521	20·512	571	22·481	621	24·449	671	26·418	721	28·386
522	20·551	572	22·520	622	24·488	672	26·457	722	28·425
523	20·591	573	22·559	623	24·528	673	26·496	723	28·465
524	20·630	574	22·599	624	24·567	674	26·536	724	28·504
525	20·669	575	22·638	625	24·607	675	26·575	725	28·544
526	20·709	576	22·677	626	24·646	676	26·614	726	28·583
527	20·748	577	22·717	627	24·685	677	26·654	727	28·622
528	20·788	578	22·756	628	24·725	678	26·693	728	28·662
529	20·827	579	22·795	629	24·764	679	26·733	729	28·701
530	20·866	580	22·835	630	24·803	680	26·772	730	28·740
531	20·906	581	22·874	631	24·843	681	26·811	731	28·780
532	20·945	582	22·914	632	24·882	682	26·851	732	28·819
533	20·984	583	22·953	633	24·921	683	26·890	733	28·859
534	21·024	584	22·992	634	24·961	684	26·929	734	28·898
535	21·063	585	23·032	635	25·000	685	26·969	735	28·937
536	21·103	586	23·071	636	25·040	686	27·008	736	28·977
537	21·142	587	23·110	637	25·079	687	27·047	737	29·016
538	21·181	588	23·150	638	25·118	688	27·087	738	29·055
539	21·221	589	23·189	639	25·158	689	27·126	739	29·095
540	21·260	590	23·229	640	25·197	690	27·166	740	29·134
541	21·299	591	23·268	641	25·236	691	27·205	741	29·173
542	21·339	592	23·307	642	25·276	692	27·244	742	29·213
543	21·378	593	23·347	643	25·315	693	27·284	743	29·252
544	21·418	594	23·386	644	25·355	694	27·323	744	29·292
545	21·457	595	23·425	645	25·394	695	27·362	745	29·331
546	21·496	596	23·464	646	25·433	696	27·402	746	29·370
547	21·536	597	23·503	647	25·473	697	27·441	747	29·410
548	21·575	598	23·543	648	25·512	698	27·481	748	29·449
549	21·614	599	23·582	649	25·551	699	27·520	749	29·488
550	21·654	600	23·622	650	25·591	700	27·559	750	29·528

EQUIVALENTS OF MILLIMETRES IN INCHES.

Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.	Inches.
751	29·567	801	31·536	851	33·504	901	35·473	951	37·441
752	29·607	802	31·575	852	33·544	902	35·512	952	37·481
753	29·646	803	31·614	853	33·583	903	35·552	953	37·520
754	29·685	804	31·654	854	33·622	904	35·591	954	37·559
755	29·725	805	31·693	855	33·662	905	35·630	955	37·599
756	29·764	806	31·733	856	33·701	906	35·670	956	37·638
757	29·803	807	31·772	857	33·740	907	35·709	957	37·677
758	29·843	808	31·811	858	33·780	908	35·748	958	37·717
759	29·882	809	31·851	859	33·819	909	35·788	959	37·756
760	29·922	810	31·890	860	33·859	910	35·827	960	37·796
761	29·961	811	31·929	861	33·898	911	35·866	961	37·835
762	30·000	812	31·969	862	33·937	912	35·906	962	37·874
763	30·040	813	32·008	863	33·977	913	35·945	963	37·914
764	30·079	814	32·048	864	34·016	914	35·985	964	37·953
765	30·118	815	32·087	865	34·055	915	36·024	965	37·992
766	30·158	816	32·126	866	34·095	916	36·063	966	38·032
767	30·197	817	32·166	867	34·134	917	36·103	967	38·071
768	30·236	818	32·205	868	34·174	918	36·142	968	38·111
769	30·276	819	32·244	869	34·213	919	36·181	969	38·150
770	30·315	820	32·284	870	34·252	920	36·221	970	38·189
771	30·355	821	32·323	871	34·292	921	36·260	971	38·229
772	30·394	822	32·362	872	34·331	922	36·300	972	38·268
773	30·433	823	32·402	873	34·370	923	36·339	973	38·307
774	30·473	824	32·441	874	34·410	924	36·378	974	38·347
775	30·512	825	32·481	875	34·449	925	36·418	975	38·386
776	30·551	826	32·520	876	34·488	926	36·457	976	38·426
777	30·591	827	32·559	877	34·528	927	36·496	977	38·465
778	30·630	828	32·599	878	34·567	928	36·536	978	38·504
779	30·670	829	32·638	879	34·607	929	36·575	979	38·544
780	30·709	830	32·677	880	34·646	930	36·615	980	38·583
781	30·748	831	32·717	881	34·685	931	36·654	981	38·622
782	30·788	832	32·756	882	34·725	932	36·693	982	38·662
783	30·827	833	32·796	883	34·764	933	36·733	983	38·701
784	30·866	834	32·835	884	34·803	934	36·772	984	38·741
785	30·906	835	32·874	885	34·843	935	36·811	985	38·780
786	30·945	836	32·914	886	34·882	936	36·851	986	38·819
787	30·985	837	32·953	887	34·922	937	36·890	987	38·859
788	31·024	838	32·992	888	34·961	938	36·929	988	38·898
789	31·063	839	33·032	889	35·000	939	36·969	989	38·937
790	31·103	840	33·071	890	35·040	940	37·008	990	38·977
791	31·142	841	33·111	891	35·079	941	37·048	991	39·016
792	31·181	842	33·150	892	35·118	942	37·087	992	39·056
793	31·221	843	33·189	893	35·158	943	37·126	993	39·095
794	31·260	844	33·229	894	35·197	944	37·166	994	39·134
795	31·299	845	33·268	895	35·237	945	37·205	995	39·174
796	31·339	846	33·307	896	35·276	946	37·244	996	39·213
797	31·378	847	33·347	897	35·315	947	37·284	997	39·252
798	31·418	848	33·386	898	35·355	948	37·323	998	39·292
799	31·457	849	33·425	899	35·394	949	37·363	999	39·331
800	31·496	850	33·465	900	35·433	950	37·402	1000	39·370

EQUIVALENTS OF FEET IN METRES.

1 Foot = ·3048 of 1 Metre.

Feet.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	·3048	·3353	·3657	·3962	·4267	·4572	·4877	·5181	·5486	·5791
2	·6096	·6401	·6705	·7010	·7315	·7620	·7925	·8229	·8534	·8839
3	·9144	·9449	·9753	1·0058	1·0363	1·0668	1·0973	1·1277	1·1582	1·1887
4	1·2192	1·2497	1·2801	1·3106	1·3411	1·3716	1·4020	1·4325	1·4630	1·4935
5	1·5240	1·5544	1·5849	1·6154	1·6459	1·6764	1·7068	1·7373	1·7678	1·7983
6	1·8288	1·8592	1·8897	1·9202	1·9507	1·9812	2·0116	2·0421	2·0726	2·1031
7	2·1336	2·1640	2·1945	2·2250	2·2555	2·2860	2·3164	2·3469	2·3774	2·4079
8	2·4384	2·4688	2·4993	2·5298	2·5603	2·5907	2·6212	2·6517	2·6822	2·7127
9	2·7431	2·7736	2·8041	2·8346	2·8651	2·8955	2·9260	2·9565	2·9870	3·0175
10	3·0479	3·0784	3·1089	3·1394	3·1699	3·2003	3·2308	3·2613	3·2918	3·3223

EQUIVALENT OF SQUARE INCHES IN SQUARE CENTIMETRES.

1 Square Inch = 6·4514 Square Centimetres.

Square Inches	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	6·451	7·096	7·742	8·387	9·032	9·677	10·322	10·967	11·612	12·258
2	12·903	13·548	14·193	14·838	15·483	16·128	16·774	17·419	18·064	18·709
3	19·354	19·999	20·644	21·289	21·935	22·580	23·225	23·870	24·515	25·160
4	25·805	26·451	27·096	27·741	28·386	29·031	29·676	30·321	30·967	31·612
5	32·257	32·902	33·547	34·192	34·837	35·482	36·128	36·773	37·418	38·063
6	38·708	39·353	39·998	40·644	41·289	41·934	42·579	43·224	43·869	44·514
7	45·160	45·805	46·450	47·095	47·740	48·385	49·030	49·675	50·321	50·966
8	51·611	52·256	52·901	53·546	54·191	54·837	55·482	56·127	56·772	57·417
9	58·062	58·707	59·353	59·998	60·643	61·288	61·933	62·578	63·223	63·868
10	64·514	65·159	65·804	66·449	67·094	67·739	68·384	69·030	69·675	70·320

EQUIVALENTS OF SQUARE FEET IN SQUARE METRES.

1 Square Foot = ·0929 of 1 Square Metre.

Square Feet.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	·0929	·1022	·1115	·1208	·1301	·1393	·1486	·1579	·1672	·1765
2	·1858	·1951	·2044	·2137	·2230	·2322	·2415	·2508	·2601	·2694
3	·2787	·2880	·2973	·3066	·3159	·3251	·3344	·3437	·3530	·3623
4	·3716	·3809	·3902	·3995	·4088	·4180	·4273	·4366	·4459	·4552
5	·4645	·4738	·4831	·4924	·5017	·5109	·5202	·5295	·5388	·5481
6	·5574	·5667	·5760	·5853	·5946	·6038	·6131	·6224	·6317	·6410
7	·6503	·6596	·6689	·6782	·6875	·6967	·7060	·7153	·7246	·7339
8	·7432	·7525	·7618	·7711	·7804	·7896	·7989	·8082	·8175	·8268
9	·8361	·8454	·8547	·8640	·8733	·8825	·8918	·9011	·9104	·9197
10	·9290	·9383	·9476	·9569	·9662	·9754	·9847	·9940	1·0033	1·0126

EQUIVALENTS OF METRES IN FEET.

1 Metre = 3·2809 Feet.

Metres.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	3·2809	3·6090	3·9371	4·2652	4·5933	4·9213	5·2494	5·5775	5·9056	6·2337
2	6·5618	6·8899	7·2180	7·5461	7·8742	8·2022	8·5303	8·8584	9·1865	9·5146
3	9·8427	10·1708	10·4989	10·8270	11·1551	11·4831	11·8112	12·1393	12·4674	12·7955
4	13·1236	13·4517	13·7798	14·1079	14·4360	14·7640	15·0921	15·4202	15·7483	16·0764
5	16·4045	16·7326	17·0607	17·3888	17·7169	18·0449	18·3730	18·7011	19·0292	19·3573
6	19·6854	20·0135	20·3416	20·6697	20·9978	21·3258	21·6539	21·9820	22·3101	22·6382
7	22·9663	23·2944	23·6225	23·9506	24·2787	24·6067	24·9348	25·2629	25·5910	25·9191
8	26·2472	26·5753	26·9034	27·2315	27·5596	27·8876	28·2157	28·5438	28·8719	29·2000
9	29·5281	29·8562	30·1843	30·5124	30·8405	31·1685	31·4966	31·8247	32·1528	32·4809
10	32·8090	33·1371	33·4652	33·7933	34·1213	34·4494	34·7775	35·1056	35·4337	35·7618

EQUIVALENTS OF SQUARE CENTIMETRES IN SQUARE INCHES.

1 Square Centimetre = ·1550 of 1 Square Inch.

Square Centimetres.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	·1550	·1705	·1860	·2015	·2170	·2325	·2480	·2635	·2700	·2945
2	·3100	·3255	·3110	·3565	·3720	·3875	·4030	·4185	·4340	·4495
3	·4650	·4805	·4960	·5115	·5270	·5425	·5580	·5735	·5890	·6045
4	·6200	·6355	·6510	·6665	·6820	·6975	·7130	·7285	·7440	·7595
5	·7750	·7005	·8060	·8215	·8370	·8525	·8680	·8835	·8990	·9145
6	·9300	·9455	·9610	·9765	·9920	1·0075	1·0230	1·0385	1·0540	1·0695
7	1·0850	1·1005	1·1160	1·1315	1·1470	1·1625	1·1780	1·1935	1·2090	1·2245
8	1·2400	1·2555	1·2710	1·2865	1·3020	1·3175	1·3330	1·3485	1·3640	1·3795
9	1·3950	1·4105	1·4260	1·4416	1·4571	1·4726	1·4881	1·5036	1·5191	1·5346
10	1·5501	1·5656	1·5811	1·5966	1·6121	1·6276	1·6431	1·6586	1·6741	1·6896

EQUIVALENTS OF SQUARE METRES IN SQUARE FEET.

1 Square Metre = 10·7643 Square Feet.

Square Metres.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	10·764	11·841	12·917	13·994	15·070	16·146	17·223	18·299	19·376	20·452
2	21·529	22·605	23·681	24·758	25·834	26·911	27·987	29·064	30·140	31·216
3	32·293	33·369	34·446	35·522	36·599	37·675	38·751	39·828	40·904	41·981
4	43·057	44·134	45·210	46·286	47·363	48·439	49·516	50·592	51·669	52·745
5	53·821	54·898	55·974	57·051	58·127	59·204	60·280	61·356	62·433	63·509
6	64·586	65·662	66·739	67·815	68·892	69·968	71·044	72·121	73·197	74·274
7	75·350	76·427	77·503	78·579	79·656	80·732	81·809	82·885	83·962	85·038
8	86·114	87·191	88·267	89·344	90·420	91·497	92·573	93·649	94·726	95·802
9	96·879	97·955	99·032	100·108	101·184	102·261	103·337	104·414	105·490	106·567
10	107·643	108·719	109·796	110·872	111·949	113·025	114·102	115·178	116·254	117·331

EQUIVALENTS OF POUNDS IN KILOGRAMMES.

1 Pound = ·45359 of 1 Kilogramme.

Pounds.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	·4536	·4989	·5443	·5897	·6350	·6804	·7257	·7711	·8165	·8618
2	·9072	·9525	·9979	1·0433	1·0886	1·1340	1·1793	1·2247	1·2701	1·3154
3	1·3608	1·4061	1·4515	1·4969	1·5422	1·5876	1·6329	1·6783	1·7236	1·7690
4	1·8144	1·8597	1·9051	1·9504	1·9958	2·0412	2·0865	2·1319	2·1772	2·2226
5	2·2680	2·3133	2·3587	2·4040	2·4494	2·4948	2·5401	2·5855	2·6308	2·6762
6	2·7216	2·7669	2·8123	2·8576	2·9030	2·9483	2·9937	3·0391	3·0844	3·1298
7	3·1751	3·2205	3·2659	3·3112	3·3566	3·4019	3·4473	3·4927	3·5380	3·5834
8	3·6287	3·6741	3·7195	3·7648	3·8102	3·8555	3·9009	3·9463	3·9916	4·0370
9	4·0823	4·1277	4·1730	4·2184	4·2638	4·3091	4·3545	4·3998	4·4452	4·4906
10	4·5359	4·5813	4·6266	4·6720	4·7174	4·7627	4·8081	4·8534	4·8988	4·9442

EQUIVALENTS OF POUNDS PER SQUARE INCH IN KILOGRAMMES PER SQUARE CENTIMETRE.

1 Pound per Square Inch = ·07031 of 1 Kilogramme per Square Centimetre.

Pounds.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	·0703	·0773	·0844	·0914	·0984	·1055	·1125	·1195	·1266	·1336
2	·1406	·1476	·1547	·1617	·1687	·1758	·1828	·1898	·1969	·2039
3	·2109	·2180	·2250	·2320	·2390	·2461	·2531	·2601	·2672	·2742
4	·2812	·2883	·2953	·3023	·3094	·3164	·3234	·3305	·3375	·3445
5	·3515	·3586	·3656	·3726	·3797	·3867	·3937	·4008	·4078	·4148
6	·4219	·4289	·4359	·4429	·4500	·4570	·4640	·4711	·4781	·4851
7	·4922	·4992	·5062	·5133	·5203	·5273	·5344	·5414	·5484	·5554
8	·5625	·5695	·5765	·5836	·5906	·5976	·6047	·6117	·6187	·6258
9	·6328	·6398	·6468	·6539	·6609	·6679	·6750	·6820	·6890	·6961
10	·7031	·7101	·7172	·7242	·7312	·7382	·7453	·7523	·7593	·7664

EQUIVALENTS OF POUNDS PER FOOT IN KILOGRAMMES PER METRE.

1 Pound per Foot = 1·48819 Kilogrammes per Metre.

Pounds per Foot.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	1·4882	1·6370	1·7858	1·9346	2·0835	2·2323	2·3811	2·5299	2·6787	2·8276
2	2·9764	3·1252	3·2740	3·4228	3·5717	3·7205	3·8693	4·0181	4·1669	4·3158
3	4·4646	4·6134	4·7622	4·9110	5·0599	5·2087	5·3575	5·5063	5·6551	5·8039
4	5·9528	6·1016	6·2504	6·3992	6·5480	6·6969	6·8457	6·9945	7·1433	7·2921
5	7·4410	7·5898	7·7386	7·8874	8·0362	8·1851	8·3339	8·4827	8·6315	8·7803
6	8·9292	9·0780	9·2268	9·3756	9·5244	9·6732	9·8221	9·9709	10·1197	10·2685
7	10·4173	10·5662	10·7150	10·8638	11·0126	11·1614	11·3103	11·4591	11·6079	11·7567
8	11·9055	12·0544	12·2032	12·3520	12·5008	12·6496	12·7984	12·9473	13·0961	13·2449
9	13·3937	13·5425	13·6914	13·8402	13·9890	14·1378	14·2866	14·4355	14·5843	14·7331
10	14·8819	15·0307	15·1796	15·3284	15·4772	15·6260	15·7748	15·9237	16·0725	16·2213

EQUIVALENTS OF KILOGRAMMES IN POUNDS.

1 Kilogramme = 2·2046 Pounds.

Kilogrammes.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	2·2046	2·4251	2·6455	2·8660	3·0865	3·3069	3·5274	3·7479	3·9683	4·1888
2	4·4092	4·6297	4·8502	5·0706	5·2911	5·5116	5·7320	5·9525	6·1729	6·3934
3	6·6139	6·8343	7·0548	7·2752	7·4957	7·7162	7·9366	0·1571	8·3776	8·5980
4	8·8185	9·0389	9·2594	9·4799	9·7003	9·9208	10·1413	10·3617	10·5822	10·8026
5	11·0231	11·2436	11·4640	11·6845	11·9050	12·1254	12·3459	12·5663	12·7768	13·0073
6	13·2277	13·4482	13·6687	13·8891	14·1096	14·3300	14·5505	14·7710	14·9914	15·2119
7	15·4323	15·6528	15·8733	16·0937	16·3142	16·5347	16·7551	16·9756	17·1960	17·4165
8	17·6370	17·8574	18·0779	18·2984	18·5188	18·7393	18·9597	19·1802	19·4007	19·6211
9	19·8416	20·0621	20·2825	20·5030	20·7234	20·9439	21·1644	21·3848	21·6053	21·8258
10	22·0462	22·2667	22·4871	22·7076	22·9281	23·1485	23·3690	23·5894	23·8099	24·0304

EQUIVALENTS OF KILOGRAMMES PER SQUARE CENTIMETRE IN POUNDS PER SQUARE INCH.

1 Kilogramme per Square Centimetre = 14·2228 Pounds per Square Inch.

Kilogrammes per Square Centimetre.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	14·223	15·645	17·067	18·490	19·912	21·334	22·757	24·179	25·601	27·023
2	28·446	29·868	31·290	32·712	34·135	35·557	36·979	38·402	39·824	41·246
3	42·668	44·091	45·513	46·935	48·358	49·780	51·202	52·624	54·047	55·469
4	56·891	58·314	59·736	61·158	62·580	64·003	65·425	66·847	68·270	69·692
5	71·114	72·536	73·959	75·381	76·803	78·226	79·648	81·070	82·492	83·915
6	85·337	86·759	88·181	89·604	91·026	92·448	93·871	95·293	96·715	98·137
7	99·560	100·982	102·404	103·827	105·249	106·671	108·093	109·516	110·938	112·360
8	113·783	115·205	116·627	118·049	119·472	120·894	122·316	123·739	125·161	126·583
9	128·005	129·428	130·850	132·272	133·695	135·117	136·539	137·961	139·384	140·806
10	142·228	143·650	145·073	146·495	147·917	149·340	150·762	152·184	153·606	155·029

EQUIVALENTS OF KILOGRAMMES PER METRE IN POUNDS PER FOOT.

1 Kilogramme per Metre = ·67196 of 1 Pound per Foot.

Kilogrammes per Metre.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	·6720	·7392	·8063	·8735	·9407	1·0079	1·0751	1·1423	1·2095	1·2767
2	1·3439	1·4111	1·4783	1·5455	1·6127	1·6799	1·7471	1·8143	1·8815	1·9487
3	2·0159	2·0831	2·1503	2·2175	2·2847	2·3518	2·4190	2·4862	2·5534	2·6206
4	2·6878	2·7550	2·8222	2·8894	2·9566	3·0238	3·0910	3·1582	3·2254	3·2926
5	3·3598	3·4270	3·4942	3·5614	3·6286	3·6958	3·7630	3·8302	3·8973	3·9645
6	4·0317	4·0989	4·1661	4·2333	4·3005	4·3677	4·4349	4·5021	4·5693	4·6365
7	4·7037	4·7709	4·8381	4·9053	4·9725	5·0397	5·1069	5·1741	5·2413	5·3085
8	5·3757	5·4428	5·5100	5·5772	5·6444	5·7116	5·7788	5·8460	5·9132	5·9804
9	6·0476	6·1148	6·1820	6·2492	6·3164	6·3836	6·4508	6·5180	6·5852	6·6524
10	6·7196	6·7868	6·8540	6·9212	6·9883	7·0555	7·1227	7·1899	7·2571	7·3243

PART V.

DETAILS.

DIMENSIONS,

PERSPECTIVE DRAWINGS,

AND

PHOTOGRAPHS.

CONTENTS OF PART V.

DIMENSIONS, ETC., OF— PAGE

Steel Joists, - - - - - - - 392

" Channels, - - - - - - 394

" Equal Angles, - - - 396

" Unequal " , - - - 398

" Tees, - - - - - - - 400

Unsymmetrical Girders, - - - - - 402

END ANGLES AND FISHPLATES, - 403

STANCHIONS –

Caps and Bases, - - - - - - 417

Splices and Connections, - - - - - 423

PLATE AND COMPOUND GIRDERS—

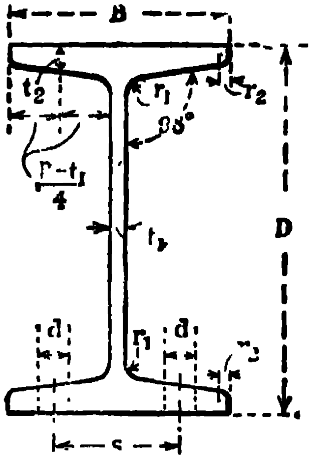
Stiffeners, - - - - - - - 429

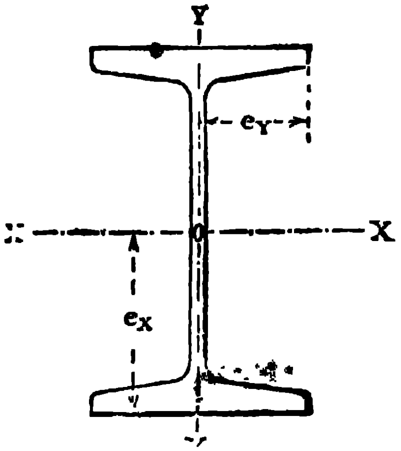
ROOF DETAILS, - - - - 430

PHOTOGRAPHS OF WORKS, - - - - - 433

REDPATH, BROWN & CO., LIMITED.

STEEL JOISTS.





D = Overall depth.
B = " breadth.
t_1 = Web thickness.
t_2 = Flange mean thickness.
r_1 = Radius of heel fillet.
r_2 = " " toe "
s = Spacing of holes.
d = Diameter of rivet or bolt.

X - X = Axis of Max. Moment of Inertia and Greatest Radius of Gyration.
Y - Y = Axis of Min. Moment of Inertia and Least Radius of Gyration.
O = Centre of Gravity of Section.
e_X = Perpendicular distance from X - X to extreme fibre.
e_Y = " " " Y - Y " " "

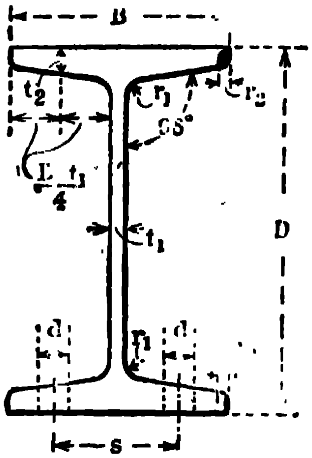
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

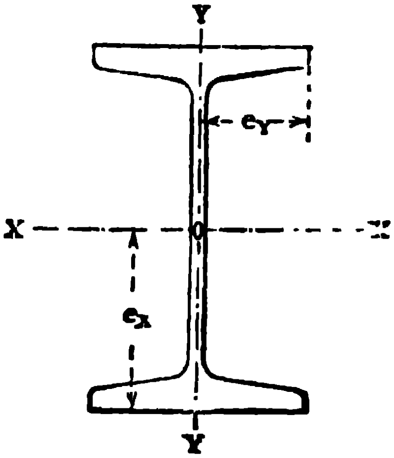
All dimensions are in Inches.

Reference Mark.	Size, D × B inches.	t_1	t_2	r_1	r_2	e_X	e_Y	s	d
B.S.B. 30	24 × 7½	·600	1·070	·700	·350	12·0	3·75	4·5	⅞ or ¾
B.S.B. 29	20 × 7½	·600	1·010	·700	·350	10·0	3·75	4·5	⅞ or ¾
B.S.B. 28	18 × 7	·550	·928	·650	·325	9·0	3·5	4·0	⅞ or ¾
B.S.B. 27	16 × 6	·550	·847	·650	·325	8·0	3·0	3·5	¾
B.S.B. 26	15 × 6	·500	·800	·600	·300	7·5	3·0	3·5	¾
B.S.B. 25	15 × 5	·420	·647	·520	·260	7·5	2·5	2·75	¾
B.S.B. 24	14 × 6a	·500	·873	·600	·300	7·0	3·0	3·5	¾
B.S.B. 23	14 × 6b	·400	·608	·500	·250	7·0	3·0	3·5	¾
B.S.B. 22	12 × 6a	·500	·883	·600	·300	6·0	3·0	3·5	¾
B.S.B. 21	12 × 6b	·400	·717	·500	·250	6·0	3·0	3·5	¾
B.S.B. 20	12 × 5	·350	·550	·450	·225	6·0	2·5	2·75	¾
B.S.B. 19	10 × 8	·600	·970	·700	·350	5·0	4·0	4·75	⅞ or ¾
B.S.B. 18	10 × 6	·400	·736	·500	·250	5·0	3·0	3·5	¾
B.S.B. 17	10 × 5	·360	·552	·460	·230	5·0	2·5	2·75	¾
B.S.B. 16	9 × 7	·550	·924	·650	·325	4·5	3·5	4·0	⅞ or ¾

REDPATH, BROWN & CO., LIMITED.

STEEL JOISTS.





D = Overall depth.
B = „ breadth.
t_1 = Web thickness.
t_2 = Flange mean thickness.
r_1 = Radius of heel fillet.
r_2 = „ „ toe „
s = Spacing of holes.
d = Diameter of rivet or bolt.

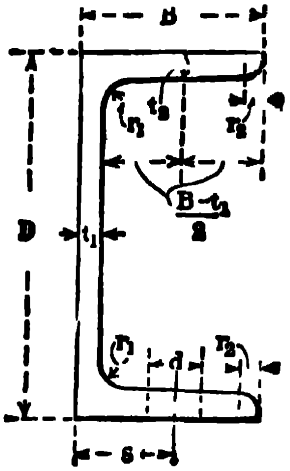
X - X = Axis of Max. Moment of Inertia and Greatest Radius of Gyration.
Y - Y = Axis of Min Moment of Inertia and Least Radius of Gyration.
O = Centre of Gravity of Section.
e_X = Perpendicular distance from X - X to extreme fibre.
e_Y = „ „ „ Y - Y „ „ „

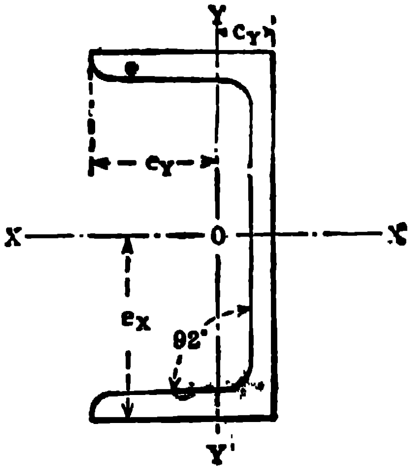
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

All dimensions are in Inches.

Reference Mark.	Size, D × B inches.	t_1	t_2	r_1	r_2	e_X	e_Y	s	d
B.S.B. 15	9 × 4	·300	·460	·400	·200	4·5	2·0	2·25	¾ or ⅝
B.S.B. 14	8 × 6	·440	·597	·540	·270	4·0	3·0	3·5	¾
B.S.B. 13	8 × 5	·350	·575	·450	·225	4·0	2·5	2·75	¾
B.S.B. 12	8 × 4	·280	·402	·380	·190	4·0	2·0	2·25	¾ or ⅝
B.S.B. 11	7 × 4	·250	·387	·350	·175	3·5	2·0	2·25	¾ or ⅝
B.S.B. 10	6 × 5	·410	·520	·510	·255	3·0	2·5	2·75	¾
B.S.B. 9	6 × 4½	·370	·431	·470	·235	3·0	2·25	2·5	¾
B.S.B. 8	6 × 3	·260	·348	·360	·180	3·0	1·5	1·5	⅝ or ½
B.S.B. 7	5 × 4½	·290	·448	·390	·195	2·5	2·25	2·5	¾
B.S.B. 6	5 × 3	·220	·376	·320	·160	2·5	1·5	1·5	⅝ or ½
B.S.B. 5	4¾ × 1¾	·180	·325	·280	·140	2·375	0·875	0·875	½ or ⅜
B.S.B. 4	4 × 3	·220	·336	·320	·160	2·0	1·5	1·5	⅝ or ½
B.S.B. 3	4 × 1¾	·170	·240	·270	·135	2·0	0·875	0·875	½ or ⅜
B.S.B. 2	3 × 3	·200	·332	·300	·150	1·5	1·5	1·5	⅝ or ½
B.S.B. 1	3 × 1½	·160	·248	·260	·130	1·5	0·75	0·75	⅜

STEEL CHANNELS.





D = Overall depth.
B = " breadth.
t_1 = Standard web thickness.
t_2 = " flange mean thickness.
r_1 = Radius of heel fillet.
r_2 = " " toe "
s = Spacing of holes.
d = Diameter of rivet or bolt.

X—X = Axis of Max. Moment of Inertia and Greatest Radius of Gyration.
Y—Y = Axis of Min. Moment of Inertia and Least Radius of Gyration.
O = Centre of Gravity of Section.
e_X = Perpendicular distance from X—X to extreme fibre.
e_Y = " " " Y—Y " " "
c_Y = " " " Y—Y " web outer surface.

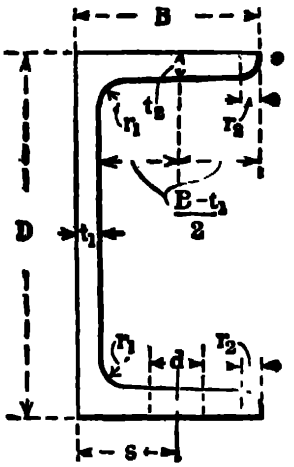
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

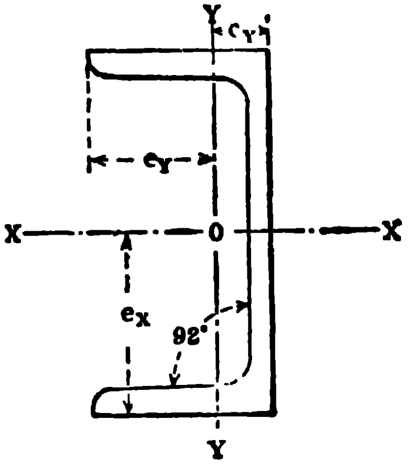
All dimensions are in Inches.

Reference Mark.	Size, D × B inches.	t_1	t_2	r_1	r_2	e_X	e_Y	c_Y	s	d
27 N	15 × 4	·525	·630	·630	·440	7·5	3·065	·935	2·25	⅞ or ¾
26 N	12 × 4	·525	·625	·625	·425	6·0	2·969	1·031	2·25	⅞ or ¾
25 N	12 × 3½	·500	·600	·600	·425	6·0	2·633	·867	2·0	¾
24 N	12 × 3½	·375	·500	·500	·350	6·0	2·640	·860	2·0	¾
23 N	11 × 4	·500	·600	·600	·425	5·5	2·937	1·063	2·25	⅞ or ¾
22 N	11 × 3½	·475	·575	·575	·400	5·5	2·604	·896	2·0	¾
21 N	10 × 4	·475	·575	·575	·400	5·0	2·898	1·102	2·25	⅞ or ¾
20 N	10 × 3½	·475	·575	·575	·400	5·0	2·567	·933	2·0	¾
19 N	10 × 3½	·375	·500	·500	·350	5·0	2·507	·933	2·0	¾
18 N	9 × 4	·475	·575	·575	·400	4·5	2·849	1·151	2·25	⅞ or ¾
17 N	9 × 3½	·450	·550	·550	·375	4·5	2·529	·971	2·0	¾
16 N	9 × 3½	·375	·500	·500	·350	4·5	2·524	·976	2·0	¾
15 N	9 × 3	·375	·437	·437	·350	4·5	2·246	·754	1·75	¾
14 N	8 × 4	·450	·550	·550	·375	4·0	2·790	1·201	2·25	⅞ or ¾

REDPATH, BROWN & CO., LIMITED.

STEEL CHANNELS.





D = Overall depth.
B = „ breadth.
t_1 = Standard web thickness.
t_2 = „ flange mean thickness.
r_1 = Radius of heel fillet.
r_2 = „ „ toe „
s = Spacing of holes.
d = Diameter of rivet or bolt.

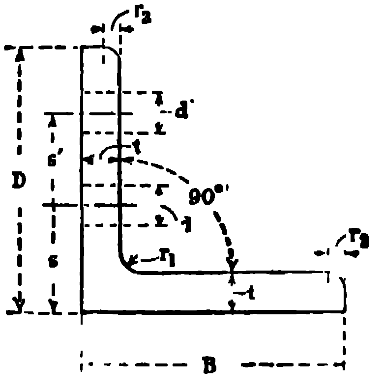
X—X = Axis of Max. Moment of Inertia and Greatest Radius of Gyration.
Y—Y = Axis of Min. Moment of Inertia and Least Radius of Gyration.
O = Centre of Gravity of Section.
e_X = Perpendicular distance from X—X to extreme fibre.
e_Y = „ „ „ Y—Y „ „ „
c_Y = „ „ „ Y—Y „ web outer surface.

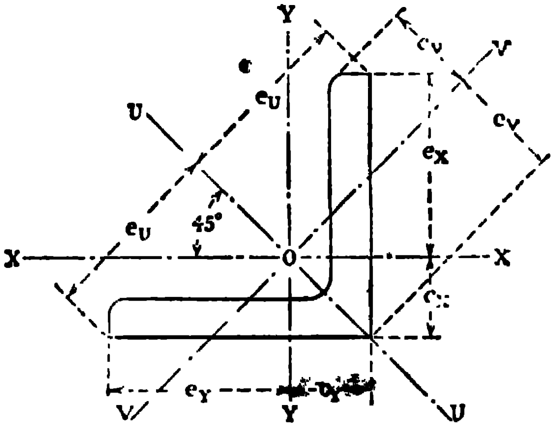
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

All dimensions are in Inches.

Reference Mark.	Size, D × B inches.	t_1	t_2	r_1	r_2	e_X	e_Y	c_Y	s	d
13 N	8 × 3½	·425	·525	·525	·375	4·0	2·489	1·011	2·0	¾
12 N	8 × 3	·375	·500	·500	·350	4·0	2·156	·844	1·75	¾
11 N	8 × 2½	·312	·437	·437	·300	4·0	1·834	·666	1·375	¾
10 N	7 × 3½	·400	·500	·500	·350	3·5	2·439	1·061	2·0	¾
9 N	7 × 3	·375	·475	·475	·325	3·5	2·126	·874	1·75	¾
8 N	6 × 3½	·375	·475	·475	·325	3·0	2·381	1·119	2·0	¾
7 N	6 × 3	·375	·475	·475	·325	3·0	2·072	·928	1·75	¾
6 N	6 × 3	·312	·437	·437	·300	3·0	2·062	·938	1·75	¾
5 N	6 × 2½	·312	·375	·375	·260	3·0	1·796	·704	1·375	¾
4 N	5 × 2½	·312	·375	·375	·260	2·5	1·743	·757	1·375	¾
3 N	4 × 2	·250	·375	·375	·200	2·0	1·344	·656	1·125	⅝
2 N	3½ × 2	·250	·312	·312	·220	1·75	1·355	·645	1·125	⅝
1 N	3 × 1½	·250	·312	·312	·220	1·5	1·016	·484	0·875	½

STEEL EQUAL ANGLES.





D & B = Overall width of legs.
t = Thickness of legs.
r_1 = Radius of heel fillet.
r_2 = " " toe "
s & s′ = Spacing of holes.
d = Diameter of rivet or bolt.
O = Centre of Gravity of Section.

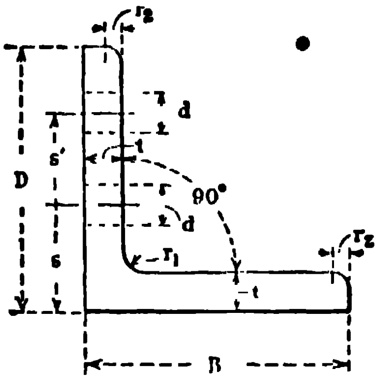
U—U = Axis of Greatest Radius of Gyration as in Part II.
V—V = Axis of Least Radius of Gyration as in Part II.
X—X, Y—Y = Axes of Moments of Inertia as in Part I.
e_U, e_V, e_X, e_Y = Perpendicular distances from Axes U—U, V—V, X—X, & Y—Y to extreme fibres.
c_V, c_X, c_Y, = Perpendicular distances from Axes V—V, X—X, & Y—Y to back lines of Section.

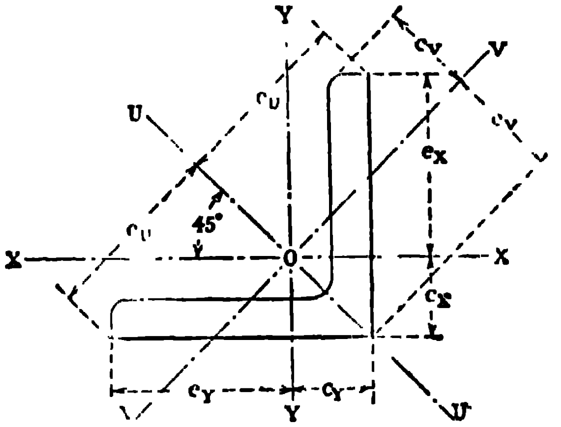
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

All dimensions are in Inches.

Reference Mark.	Size, D × B × t inches.	r_1	r_2	e_U	e_V	e_X e_Y	c_V	c_X c_Y	s	s′	d
14*g* Q	6 × 6 × $\frac{3}{4}$	·475	·325	4·24	2·49	4·24	2·15	1·76	2·25	2·25	$\frac{7}{8}$ or $\frac{3}{4}$
14*f* Q	" × $\frac{5}{8}$	"	"	"	2·42	4·29	2·13	1·71	"	"	"
14*e* Q	" × $\frac{1}{2}$	"	"	"	2·35	4·34	2·11	1·66	"	"	"
13*g* Q	5 × 5 × $\frac{3}{4}$	·425	·300	3·54	2·14	3·49	1·80	1·51	2·0	1·75	$\frac{3}{4}$
13*f* Q	" × $\frac{5}{8}$	"	"	"	2·07	3·54	1·78	1·46	"	"	"
13*e* Q	" × $\frac{1}{2}$	"	"	"	2·00	3·58	1·76	1·42	"	"	"
12*g* Q	$4\frac{1}{2}$ × $4\frac{1}{2}$ × $\frac{3}{4}$	·400	·275	3·18	1·96	3·11	1·64	1·39	2·5		$\frac{3}{4}$
12*f* Q	" × $\frac{5}{8}$	"	"	"	1·90	3·16	1·61	1·34	"		"
12*e* Q	" × $\frac{1}{2}$	"	"	"	1·83	3·21	1·59	1·29	"		"
11*g* Q	4 × 4 × $\frac{3}{4}$	·350	·250	2·88	1·79	2·74	1·47	1·26	2·25		$\frac{3}{4}$
11*f* Q	" × $\frac{5}{8}$	"	"	"	1·72	2·78	1·44	1·22	"		"
11*e* Q	" × $\frac{1}{2}$	"	"	"	1·66	2·83	1·42	1·17	"		"
11*d* Q	" × $\frac{3}{8}$	"	"	"	1·59	2·88	1·40	1·12	"		"

STEEL EQUAL ANGLES.





D & B = Overall width of legs.
t = Thickness of legs.
r_1 = Radius of heel fillet.
r_2 = " " toe "
s & s' = Spacing of holes.
d = Diameter of rivet or bolt.
O = Centre of Gravity of Section

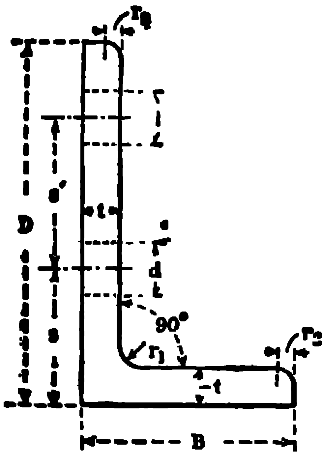
U—U = Axis of Greatest Radius of Gyration as in Part II.
V—V = Axis of Least Radius of Gyration as in Part II.
X–X, Y–Y = Axes of Moments of Inertia as in Part I.
e_U, e_V, e_X, e_Y = Perpendicular distances from Axes U—U, V—V, X—X, & Y—Y to extreme fibres.
c_V, c_X, c_Y = Perpendicular distances from Axes V—V, X--X, & Y—Y to back lines of Section.

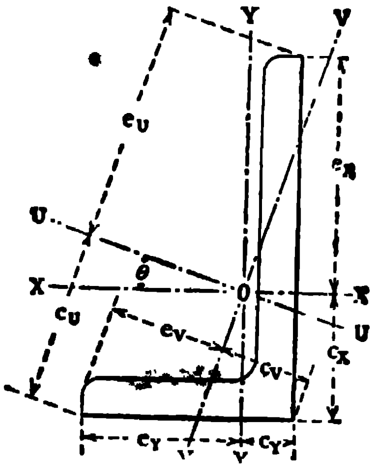
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

All dimensions are in Inches.

Reference Mark.	Size, D × B × t inches.	r_1	r_2	e_U	e_V	e_X e_Y	c_V	c_X c_Y	s	s'	d
10*f* Q	3½×3½×⅝	·325	·225	2·47	1·55	2·41	1·28	1·09	2·0		¾
10*e* Q	" ×½	"	"	"	1·48	2·45	1·25	1·05	"		"
10*d* Q	" ×⅜	"	"	"	1·41	2·50	1·23	1·00	"		"
9*f* Q	3 ×3 ×⅝	·300	·200	2·12	1·37	2·03	1·11	0·97	1·75		¾ or ⅝
9*e* Q	" ×½	"	"	"	1·31	2·08	1·09	0·92	"		"
9*d* Q	" ×⅜	"	"	"	1·24	2·12	1·06	0·88	"		"
9*c* Q	" ×5/16	"	"	"	1·21	2·15	1·05	0·85	"		"
9*b* Q	" ×¼	"	"	"	1·17	2·17	1·05	0·83	"		"
7*e* Q	2½×2½×½	·275	·200	1·77	1·13	1·70	0·91	0·80	1·375		⅝ or ½
7*d* Q	" ×⅜	"	"	"	1·06	1·75	0·89	0·75	"		"
7*c* Q	" ×5/16	"	"	"	1·03	1·77	0·87	0·73	"		"
7*b* Q	" ×¼	"	"	"	0·99	1·80	0·87	0·70	"		"
6*c* Q	2¼×2¼×5/16	·250	·175	1·59	0·94	1·58	0·80	0·67	1·25		⅝ or ½
6*b* Q	" ×¼	"	"	"	0·91	1·61	0·79	0·64	"		"
5*b* Q	2 ×2 ×¼	·250	·175	1·41	0·82	1·42	0·70	0·58	1·125		⅝ or ½
5*a* Q	" ×3/16	"	"	"	0·78	1·45	0·69	0·55	"		"

STEEL UNEQUAL ANGLES.





D & B = Overall width of legs.
t = Thickness of legs.
r_1 = Radius of heel fillet.
r_2 = " " toe "
s & s' = Spacing of holes.
d = Diameter of rivet or bolt.
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U—U = Axis of Greatest Radius of Gyration as in Part II.
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X—X, Y—Y = Axes of Moments of Inertia as in Part I.
e_U, e_V, e_X, e_Y = Perpendicular distances from axes U—U, V—V, X—X, and Y—Y to extreme fibres.
c_U, c_V, c_X, c_Y = Perpendicular distances from axes U—U, V—V, X—X, and Y—Y to back lines of Section.

θ = Angle enclosed between { Axis X—X and Axis U—U. / " Y—Y " V—V.

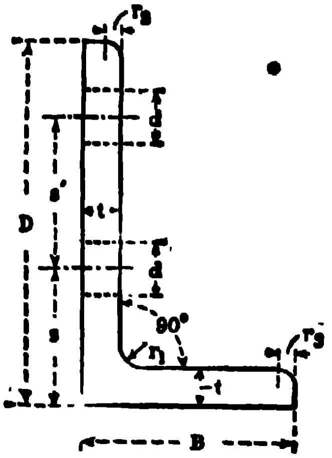
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

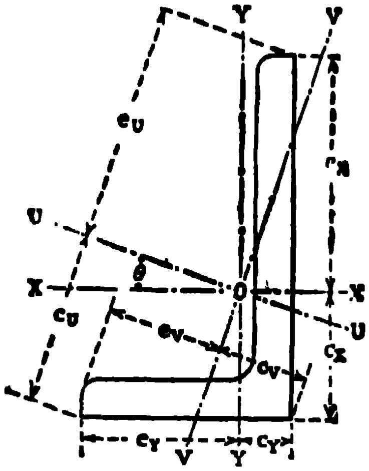
All dimensions are in Inches.

Reference Mark.	Size, D × B × t inches.	r_1	r_2	e_U	e_V	e_X	e_Y	c_U	c_V	c_X	c_Y	s	s'	d	θ
25*g* R	7 × 3½ × ¾	·425	·300	4·48	2·03	4·40	2·64	3·16	1·46	2·60	0·86	2·5	3·0	⅞ or ¾	14
25*f* R	" × ⅝	"	"	4·51	2·05	4·45	2·69	3·14	1·42	2·55	0·81	"	"	"	14·5
25*e* R	" × ½	"	"	4·55	2·07	4·50	2·74	3·11	1·36	2·50	0·76	"	"	"	14·5
21*f* R	6 × 4 × ⅝	·425	·300	4·06	2·08	3·99	2·98	3·03	1·74	2·01	1·02	2·25	2·25	⅞ or ¾	23·5
21*e* R	" × ½	"	"	4·09	2·08	4·04	3·03	3·01	1·67	1·96	0·97	"	"	"	23·5
20*f* R	6 × 3½ × ⅝	·400	·275	3·96	1·94	3·89	2·63	2·83	1·49	2·11	0·87	2·25	2·25	⅞ or ¾	18·5
20*e* R	" × ½	"	"	3·99	1·92	3·94	2·68	2·85	1·45	2·06	0·82	"	"	"	19·0
20*d* R	" × ⅜	"	"	4·02	1·96	3·99	2·73	2·79	1·38	2·01	0·77	"	"	"	19·0
68*f* R	6 × 3 × ⅝	·400	·275	3·84	1·76	3·78	2·27	2·70	1·25	2·22	0·73	2·25	2·25	⅞ or ¾	14·0
68*e* R	" × ½	"	"	3·88	1·76	3·83	2·32	2·68	1·23	2·17	0·68	"	"	"	14·5
68*d* R	" × ⅜	"	"	3·91	1·80	3·88	2·37	2·65	1·14	2·12	0·63	"	"	"	14·5

REDPATH, BROWN & CO., LIMITED.

STEEL UNEQUAL ANGLES.





D & B = Overall width of legs.
t = Thickness of legs.
r_1 = Radius of heel fillet.
r_2 = " " toe "
s & s' = Spacing of holes.
d = Diameter of rivet or bolt.
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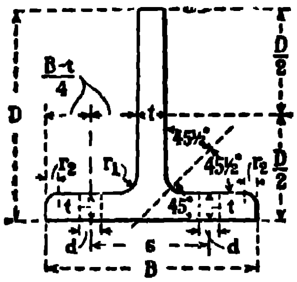
θ = Angle enclosed between { Axis X—X and Axis U—U. / " Y—Y " V—V.

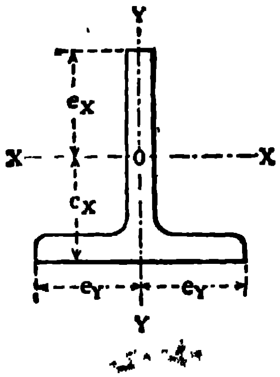
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

All dimensions are in Inches.

Reference Mark.	Size, D × B × t inches.	r_1	r_2	e_U	e_V	e_X	e_Y	c_U	c_V	c_X	c_Y	s	s'	d	θ
17*f* R	5 × 4 × $\frac{5}{8}$	·400	·275	3·46	1·81	3·40	2·89	2·89	1·79	1·60	1·11	2·0	1·75	$\frac{3}{4}$	32·0
17*e* R	" × $\frac{1}{2}$	"	"	3·48	1·83	3·44	2·94	2·88	1·73	1·56	1·06	"	"	"	32·0
17*d* R	" × $\frac{3}{8}$	"	"	3·49	1·82	3·49	2·99	2·86	1·66	1·51	1·01	"	"	"	32·0
15*f* R	5 × 3 × $\frac{5}{8}$	·350	·250	3·30	1·65	3·22	2·21	2·40	1·33	1·78	0·79	2·0	1·75	$\frac{3}{4}$	19·0
15*e* R	" × $\frac{1}{2}$	"	"	3·32	1·65	3·27	2·26	2·38	1·27	1·73	0·74	"	"	"	19·5
15*d* R	" × $\frac{3}{8}$	"	"	3·36	1·67	3·32	2·31	2·37	1·21	1·68	0·69	"	"	"	19·5
11*e* R	4 × 3 × $\frac{1}{2}$	·325	·225	2·75	1·45	2·69	2·18	2·19	1·35	1·31	0·82	2·25		$\frac{3}{4}$	28·5
11*d* R	" × $\frac{3}{8}$	"	"	2·77	1·45	2·73	2·23	2·18	1·28	1·27	0·77	"		"	28·5
7*d* R	3 × $2\frac{1}{2}$ × $\frac{3}{8}$	·275	·200	2·09	1·11	2·06	1·80	1·79	1·11	0·94	0·70	1·75		$\frac{3}{4}$ or $\frac{5}{8}$	34·0
7*e* R	" × $\frac{5}{16}$	"	"	2·10	1·10	2·08	1·83	1·79	1·07	0·92	0·67	"		"	34·0

STEEL TEES.





B = Overall width of table.
D = " depth over stalk.
t = Mean Thickness (table and stalk).
r_1 = Radius of heel fillet.
r_2 = " " toe "
s = Spacing of holes.
d = Diameter of rivet or bolt.

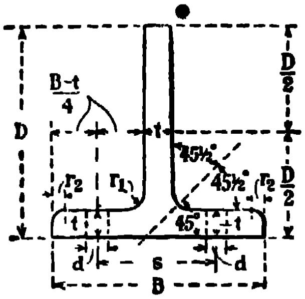
X—X, Y—Y = Axes of Max. and Min. Moments of Inertia and Greatest and Least Radii of Gyration.
O = Centre of Gravity of Section.
e_X, e_Y = Perpendicular distances from Axes X—X and Y—Y to extreme fibres.
c_X = Perpendicular distance from X—X to table outer surface.

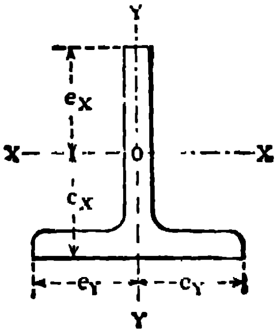
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

All Dimensions are in Inches.

Reference Mark.	Size, B × D × t inches.	r_1	r_2	e_X	e_Y	c_X	s	d
21*e* W	6 × 4 × ½	·425	·300	3·03	3·0	0·97	3·5	⅞ or ¾
20*e* W	6 × 3 × ½	·400	·275	2·32	3·0	0·68	3·5	⅞ or ¾
20*d* W	" × ⅜	"	"	2·37	3·0	0·63	"	"
19*e* W	5 × 4 × ½	·400	·275	2·95	2·5	1·05	2·75	¾
19*d* W	" × ⅜	"	"	3·00	2·5	1·00	"	"
17*e* W	5 × 3 × ½	·350	·250	2·26	2·5	0·74	2·75	¾
17*d* W	" × ⅜	"	"	2·31	2·5	0·69	"	"
16*e* W	4 × 5 × ½	·400	·275	3·47	2·0	1·53	2·25	¾
10*d* W	" × ⅜	"	"	3·53	2·0	1·47	"	"

STEEL TEES.





B = Overall width of table.
D = " depth over stalk.
t = Mean Thickness (table and stalk).
r_1 = Radius of heel fillet.
r_2 = " " toe "
s = Spacing of holes.
d = Diameter of rivet or bolt.

X—X, Y—Y = Areas of Max. and Min. Moments of Inertia and Greatest and Least Radii of Gyration.
O = Centre of Gravity of Section.
e_X, e_Y = Perpendicular distances from Axes X—X and Y—Y to extreme fibres.
c_X = Perpendicular distance from X—X to table outer surface.

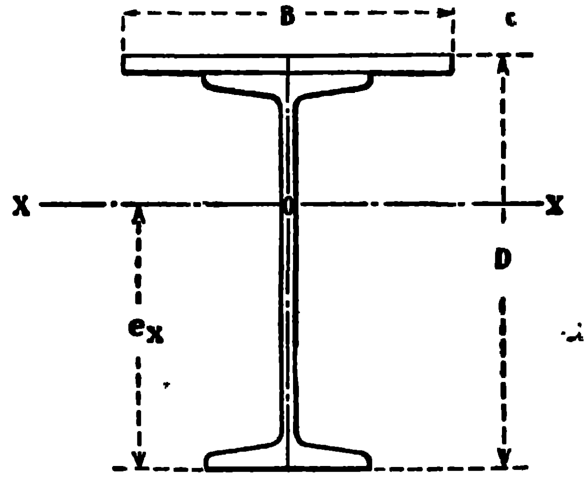
Dimensions, Position of Centre of Gravity, and Spacing of Holes.

All Dimensions are in Inches.

Reference Mark.	Size, B × D × t inches.	r_1	r_2	e_X	e_Y	c_X	s	d
15*c* W	4 × 4 × ½	·350	·250	2·84	2·0	1·16	2·25	¾
15*d* W	" × ⅝	"	"	2·89	2·0	1·11	"	"
14*e* W	4 × 3 × ½	·325	·225	2·18	2·0	0·82	2·25	¾
14*d* W	" × ⅝	"	"	2·23	2·0	0·77	"	"
13*e* W	3½ × 3½ × ½	·325	·225	2·46	1·75	1·04	2·0	¾
13*d* W	" × ⅝	"	"	2·51	1·75	0·99	"	"
11*e* W	3 × 3 × ½	·300	·200	2·08	1·50	0·92	1·5	¾ or ⅝
11*d* W	" × ⅝	"	"	2·13	1·50	0·87	"	"
8*d* W	2½ × 2½ × ⅜	·275	·200	1·75	1·25	0·75	1·25	½
8*b* W	" × ¼	"	"	1·80	1·25	0·70	"	"

COMPOUND GIRDERS.

(Part I., pages 68-69).



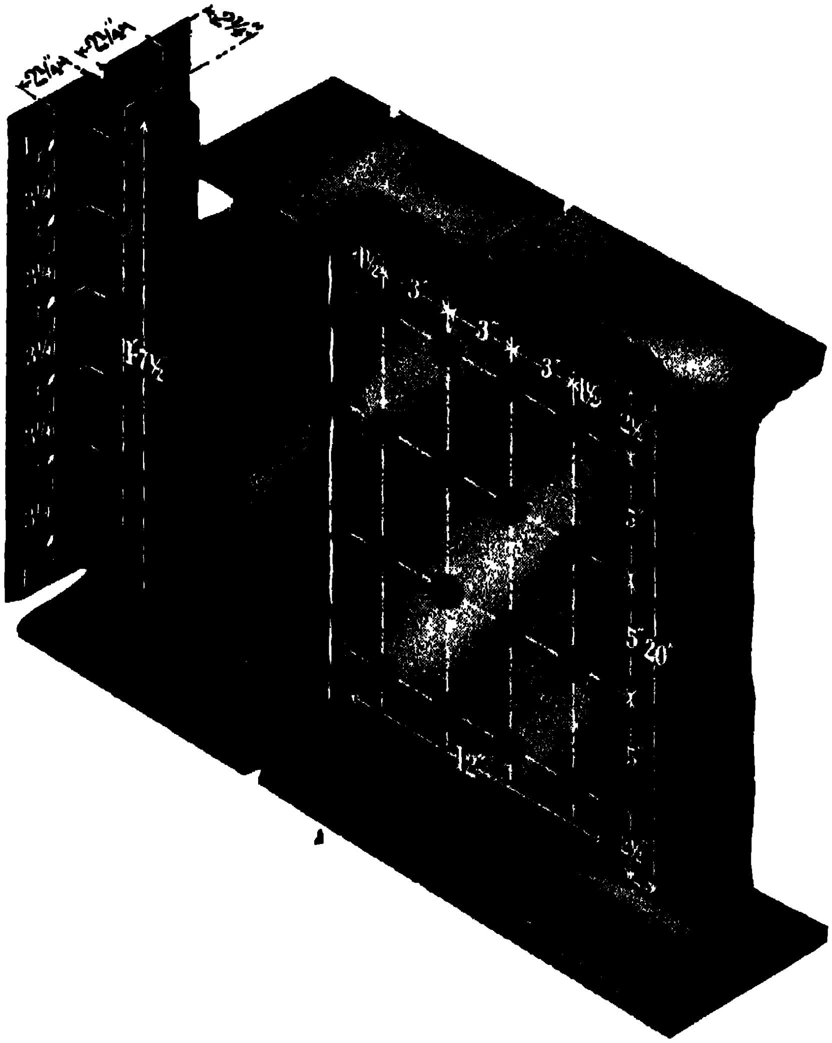
B = Overall width of flange plate.
D = Overall depth.
X—X = Axis of Max. Mom. of Inertia. (See Part I.).
O = Centre of Gravity of Section.
e_x = Perpendicular distance from Axis X—X to extreme fibre, in inches.

Position of Centre of Gravity.

Reference Mark.	Size, D × B inches.	e_x	Reference Mark.	Size, D × B inches.	e_x
			15 D	12½ × 12	8·00
29 D	16⅝ × 12	10·42	14 D	12⅜ × "	7·60
28 D	16½ × "	10·04	13 D	12⅝ × 10	8·52
27 D	15⅝ × "	9·86	12 D	12½ × "	8·17
26 D	15½ × "	9·50	11 D	12⅜ × "	7·76
25 D	15⅝ × 10	10·12	10 D	10⅝ × 12	7·01
24 D	15½ × "	9·73	9 D	10½ × "	6·72
23 D	15⅜ × "	9·20	8 D	10⅝ × 10	7·20
22 D	14⅝ × 12	9·26	7 D	10½ × "	6·89
21 D	14½ × "	9·00	6 D	10⅜ × "	6·55
20 D	14⅝ × "	9·62	5 D	8⅝ × 12	5·82
19 D	14½ × "	9·23	4 D	8½ × "	5·56
18 D	12⅝ × "	8·02	3 D	8⅝ × "	5·86
17 D	12½ × "	7·70	2 D	8½ × 10	5·60
16 D	12⅝ × "	8·32	1 D	8⅜ × "	5·29

END ANGLES AND FISHPLATES.

STANDARD DETAILS.

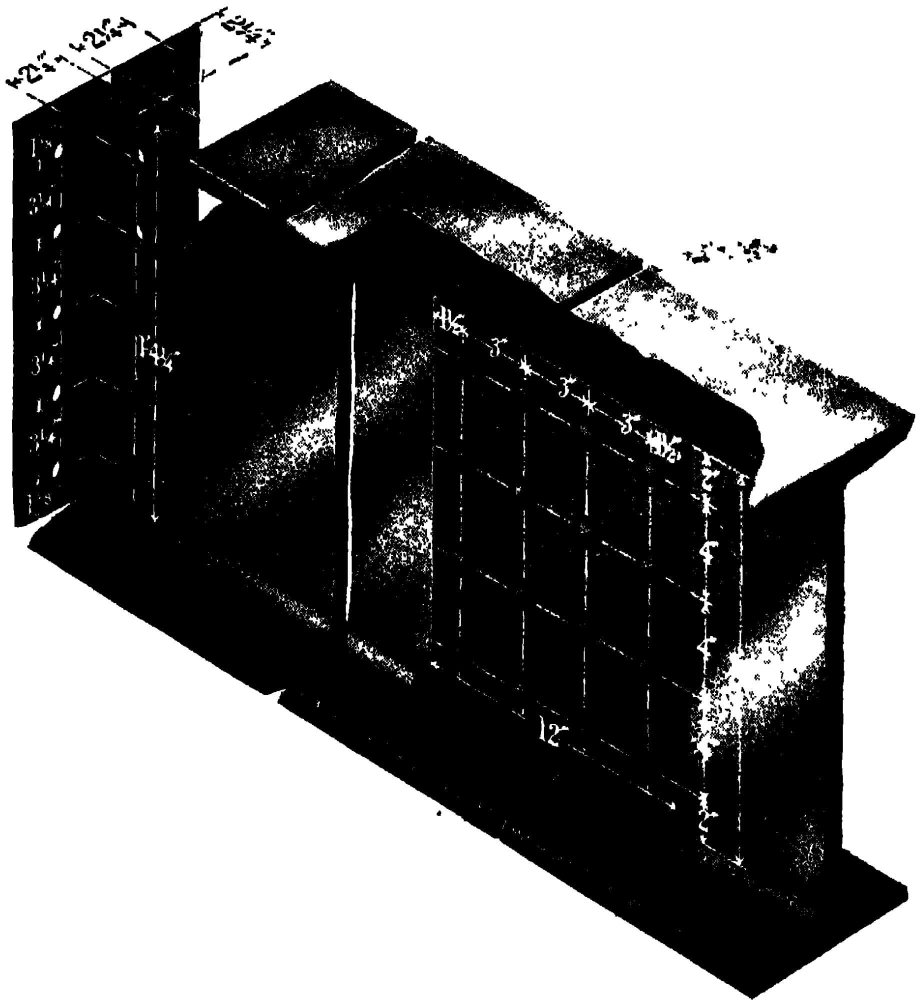


STEEL JOIST. 24" x 7½" x 100 LBS.

ANGLE CLEATS. 4" x 4" x ½" x 1' 7½". FISHPLATES. 20" x 12" x ½".
MINIMUM SPAN. 16 FEET. HOLES. 15/16" DIAMETER.
MAXIMUM LOAD. 34 TONS. BOLTS OR RIVETS. ⅞" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOIST. 20" x 7½" x 89 LBS.

ANGLE CLEATS. 4" x 4" x ½" x 1' 4¼"

FISHPLATES. 16" x 12" x ½".

MINIMUM SPAN. 15 FEET.

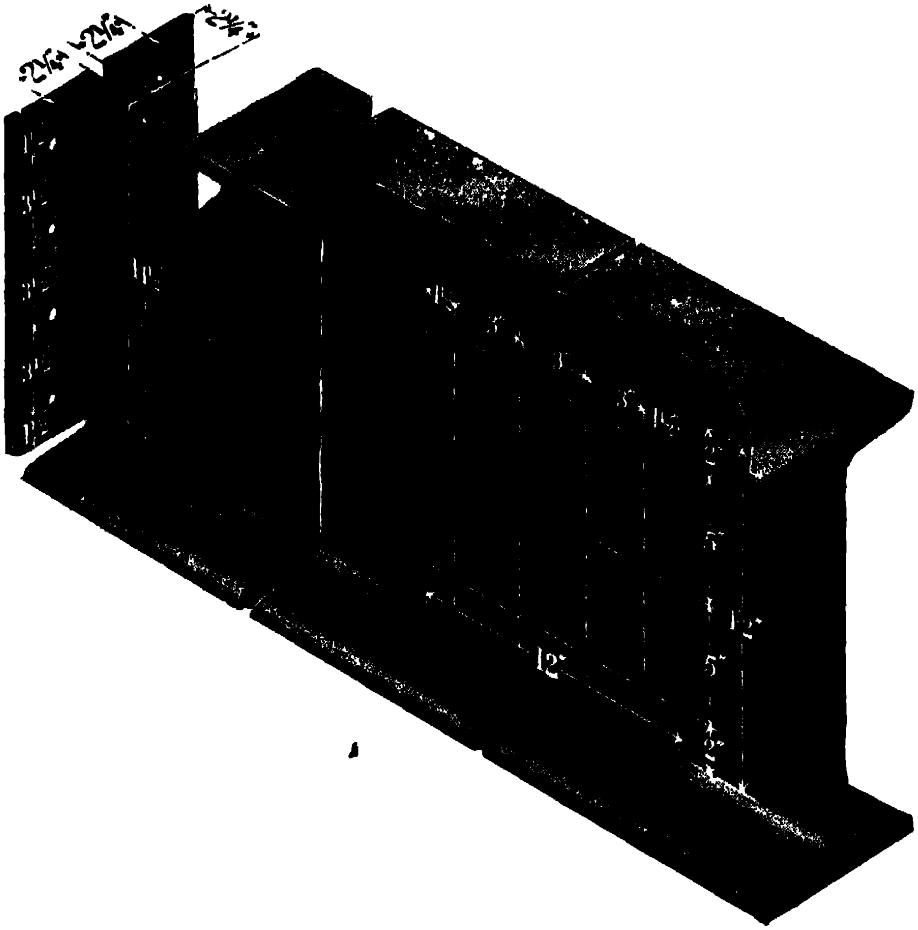
HOLES. 15/16" DIAMETER.

MAXIMUM LOAD. 29 TONS.

BOLTS OR RIVETS, ⅞" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.

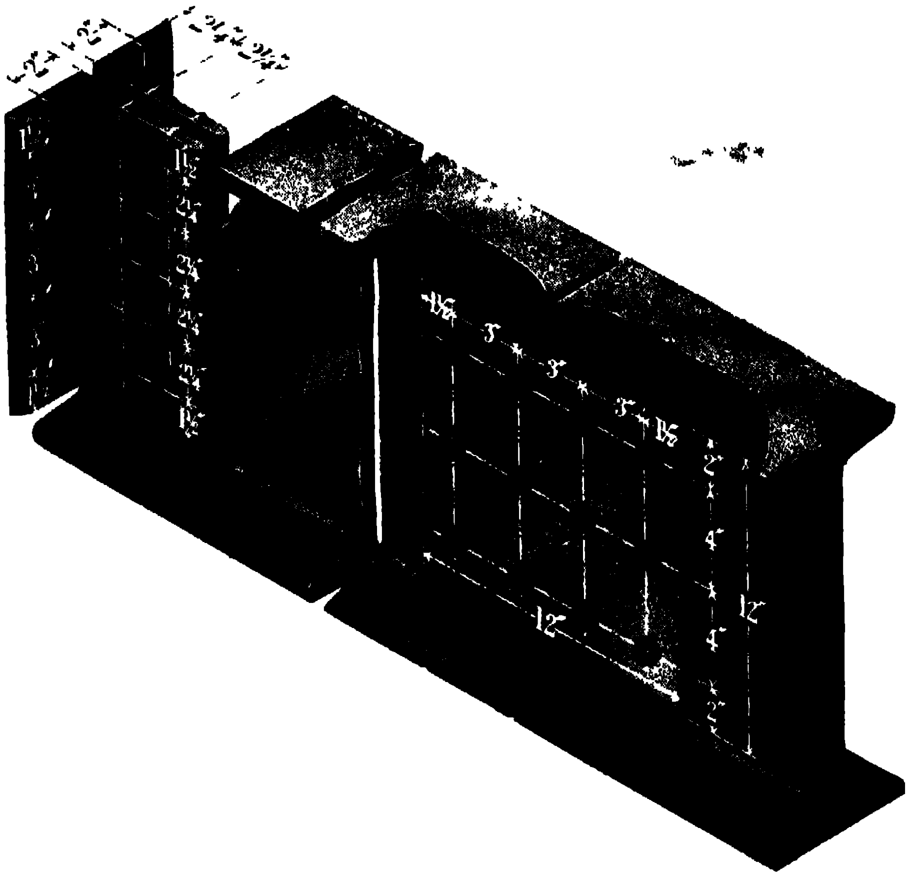


STEEL JOIST, 18" x 7" x 75 LBS.

ANGLE CLEATS. 4" x 4" x ½" x 1'·1½"   FISHPLATES, 14" x 12" x ½".
MINIMUM SPAN, 15 FEET.   HOLES, 15/16" DIAMETER.
MAXIMUM LOAD, 21 TONS.   BOLTS OR RIVETS, ⅞" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



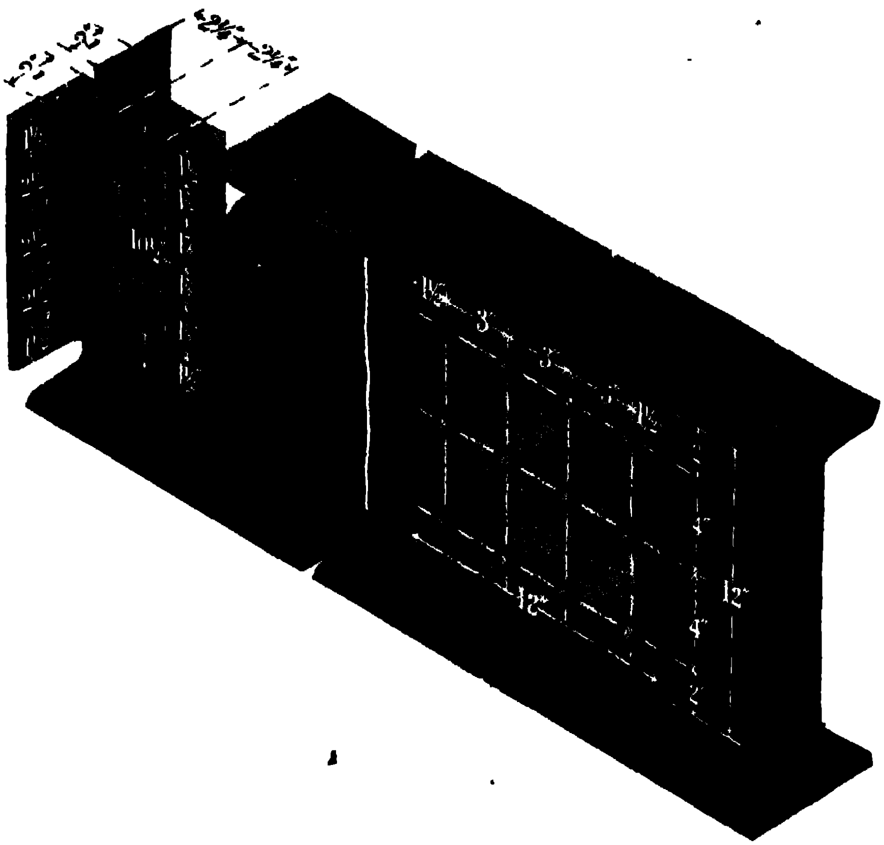
STEEL JOIST. 16"x 6"x 62 LBS.

ANGLE CLEATS. 6"x3½"x½"x1'0"
MINIMUM SPAN. 11 FEET.
MAXIMUM LOAD. 22 TONS.

FISHPLATES, 12"x12"x½".
HOLES. 13/16" DIAMETER.
BOLTS OR RIVETS. ¾" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS.

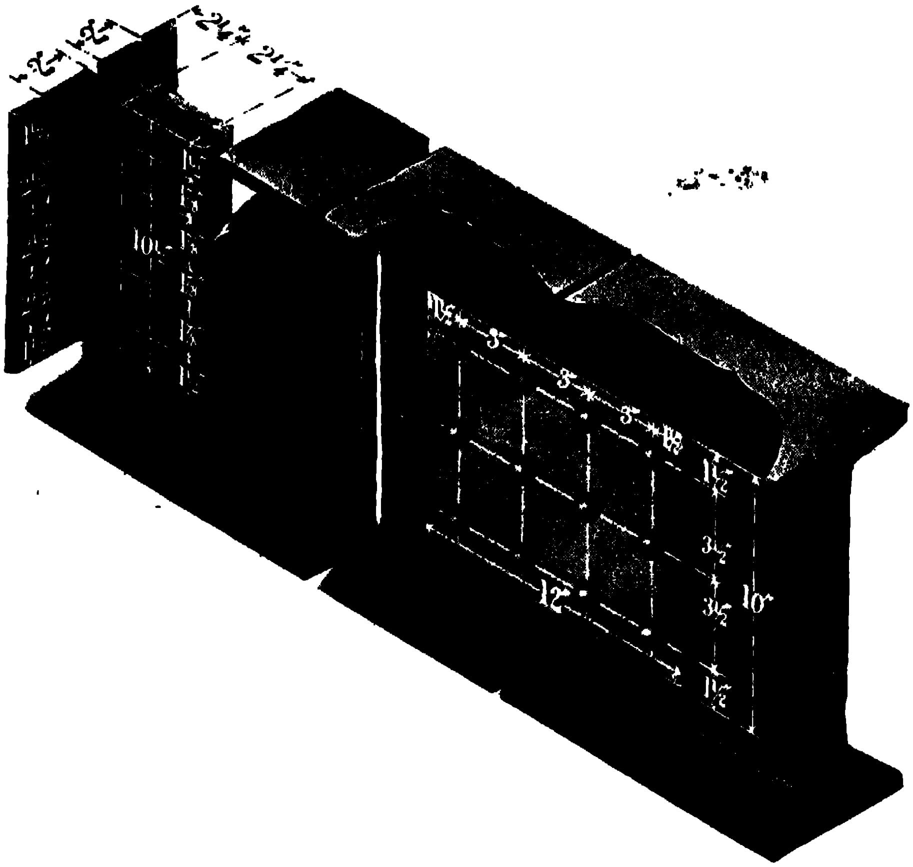
Steel Joists	Min. Span.	Max. Load.
15"x 6"x 59 lbs.	10 Feet.	20 Tons.
15"x 5"x 42 „	9 „	17 „

Angle Cleats. 6"x 3½"x ½"x 10½". Holes, 13/16" Diameter.

Fishplates. 12"x 12"x ½". Bolts or Rivets. ¾" Diameter.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS

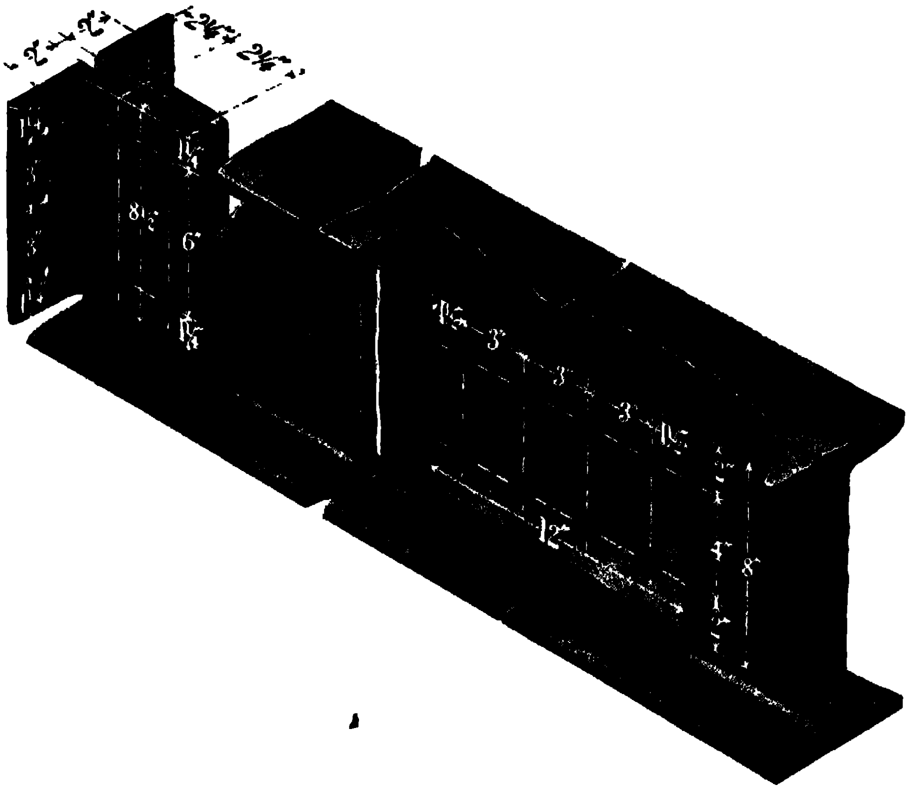
Steel Joists.	Min. Span.	Max. Load.
14"x 6"x 57 lbs.	10 Feet.	20 Tons.
14"x 6"x 46 „	10 „	16 „

Angle Cleats. 6"x 3½"x ½"x 10½" Holes, 13/16" Diameter.

Fishplates, 12"x 10"x ½". Bolts or Rivets, ¾" Diameter.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL-JOISTS.

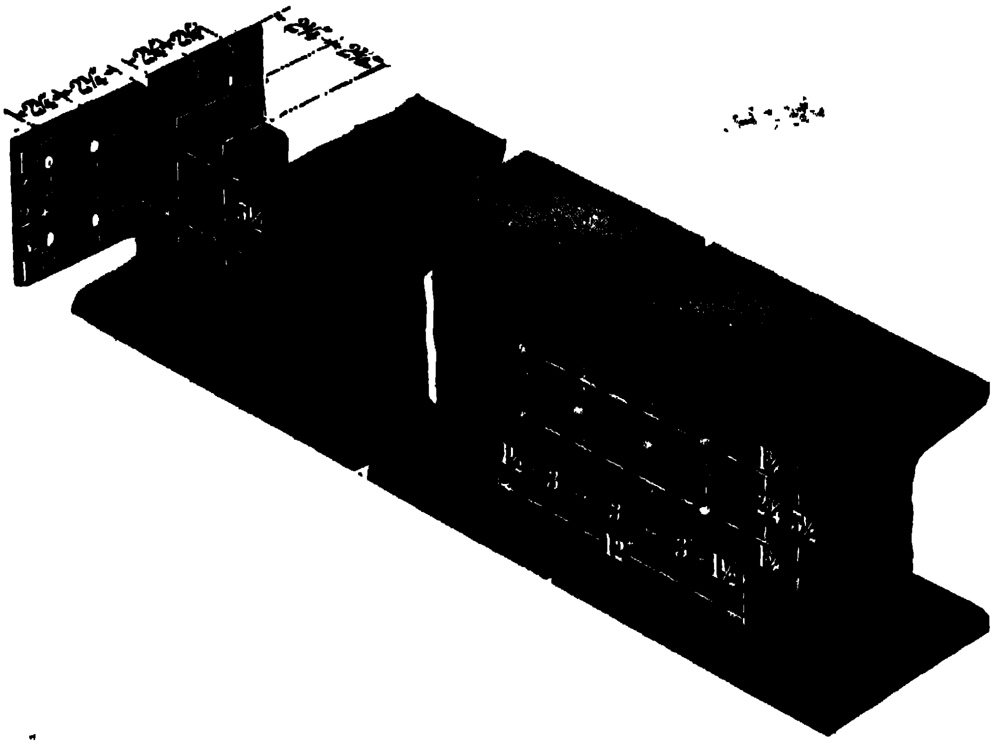
STEEL JOISTS.	MIN. SPAN.	MAX. LOAD.
12"x6" x 54 LBS.	10 FEET.	16 TONS.
12"x6" x44 "	10 "	13 "
12"x 5"x 32 "	8 "	11 "

ANGLE CLEATS. 6"x3½"x½"x8½" HOLES. 13/16" DIAMETER.

FISHPLATES. 8" x12"x ½". BOLTS OR RIVETS. ¾" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS

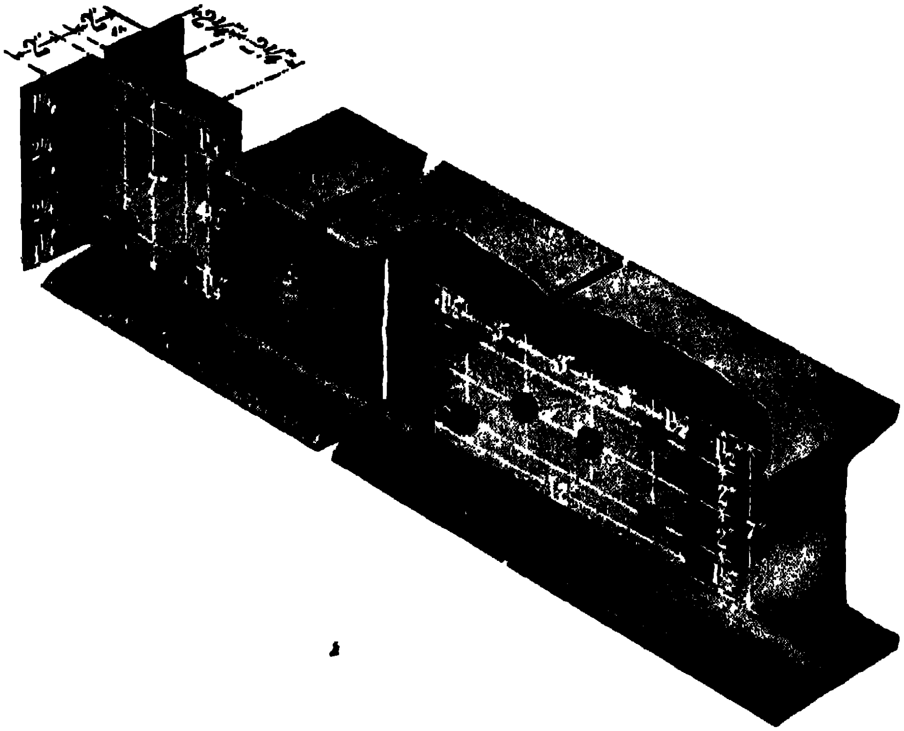
STEEL JOISTS.	MIN. SPAN.	MAX. LOAD.
10"x 8"x 70 LBS.	8 FEET.	23 TONS.
9"x 7"x 58 „	6 „	21 „

ANGLE CLEATS. 6"x6"x½"x5½". HOLES. 15/16" DIAMETER.

FISHPLATES. 5½"x12"x½". BOLTS OR RIVETS. ⅞" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.

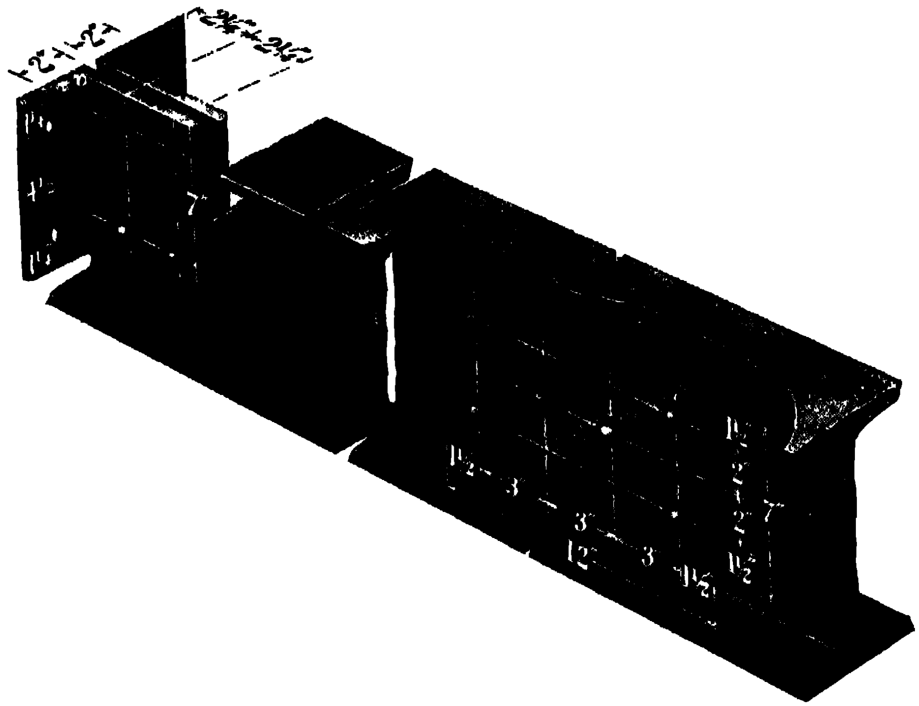


STEEL JOIST. 10"x 6"x 42 LBS.

ANGLE CLEATS. 6"x3½"x½"x7."	FISHPLATES. 7"x12"x½".
MINIMUM SPAN. 8 FEET.	HOLES. 13/16" DIAMETER.
MAXIMUM LOAD. 13 TONS.	BOLTS OR RIVETS. ¾" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS.

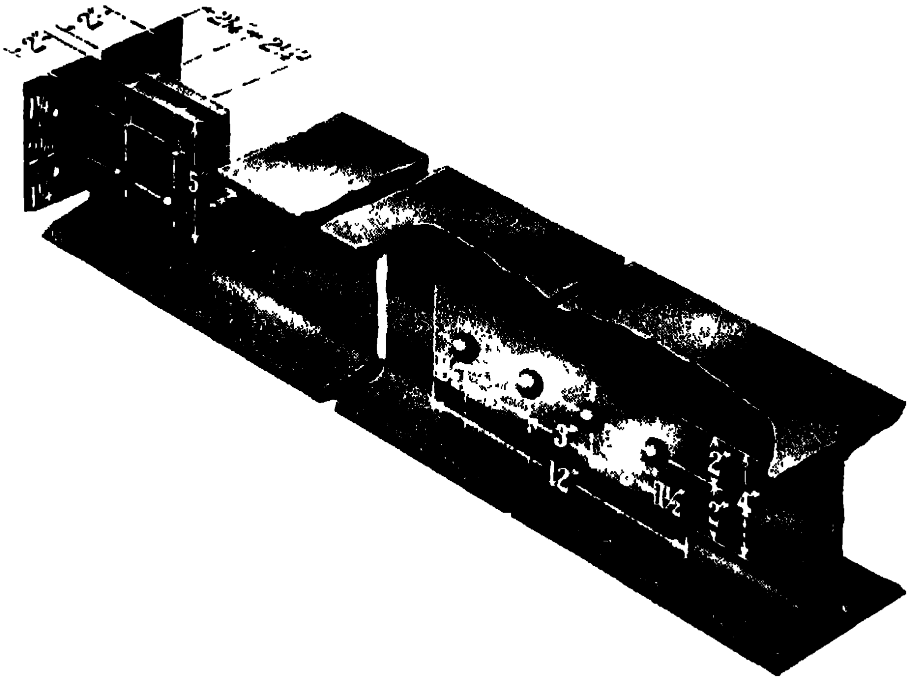
Steel Joists.	Min. Span.	Max. Load.
10" x 5" x 30 lbs.	6 Feet.	12 Tons.
9" x 4" x 21 „	5 „	10 „

Angle Cleats. 6" x 3½" x ½" x 7". Holes, 13/16 Diameter.

Fishplates. 7" x 12" x ½". Bolts or Rivets. ¾" Diameter.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS.

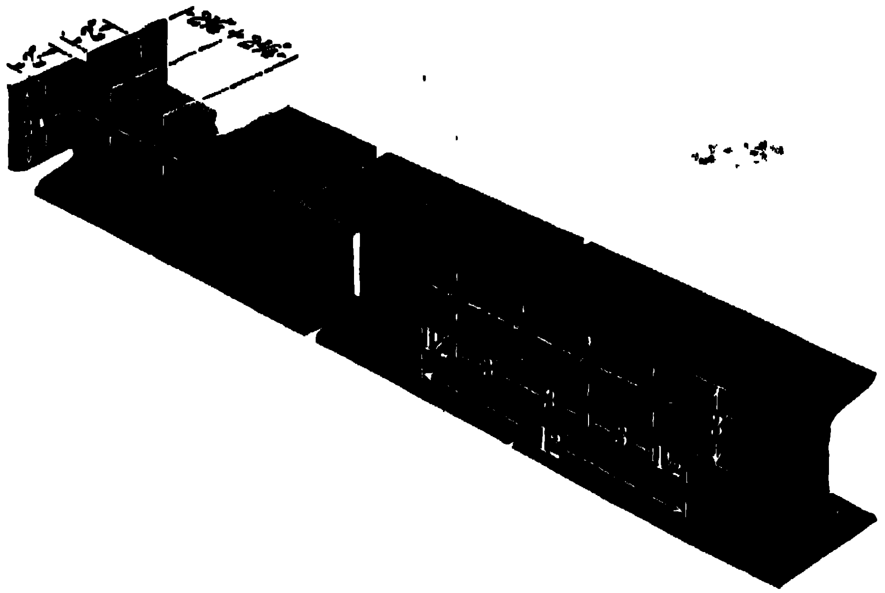
STEEL JOISTS.	MIN SPAN.	MAX. LOAD.
8" x 6" x 35 LBS.	5 FEET.	14 TONS.
8" x 5" x 28 „	5 „	11 „
8" x 4" x 18 „	4 „	9 „
7" x 4" x 16 „	4 „	8 „

ANGLE CLEATS. 6"x3½"x½"x5". HOLES. 13/16 DIAMETER.

FISHPLATES. 4"x12"x½". BOLTS OR RIVETS, ¾" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS.

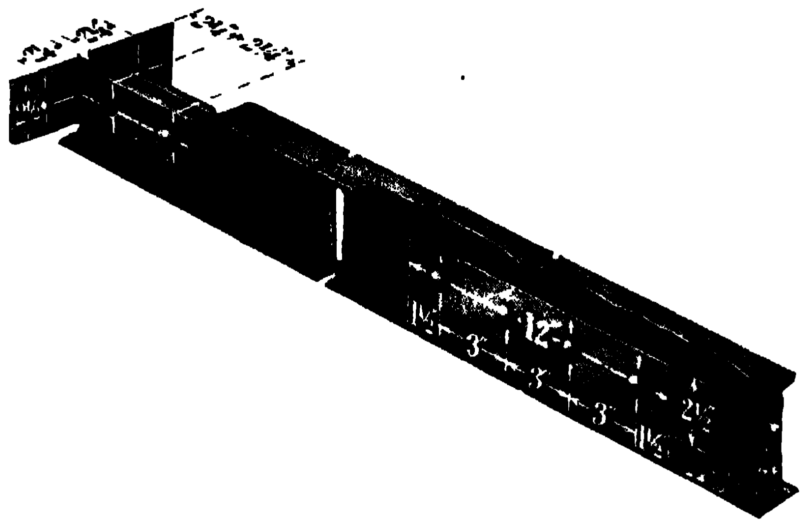
STEEL JOISTS.	MIN SPAN.	MAX. LOAD.
6" x 5" x 25 LBS.	6 FEET.	6 TONS.
6" x 4½" x 20 „	5 „	6 „
6" x 3" x 12 „	4 „	4 „
5" x 4½" x 18 „	4 „	6 „
5" x 3" x 11 „	3 „	5 „

ANGLE CLEATS. 6" x 3½" x ½" x 3". HOLES. 13/16" DIAMETER.

FISHPLATES. 3" x 12" x ½". BOLTS OR RIVETS, ¾" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS.

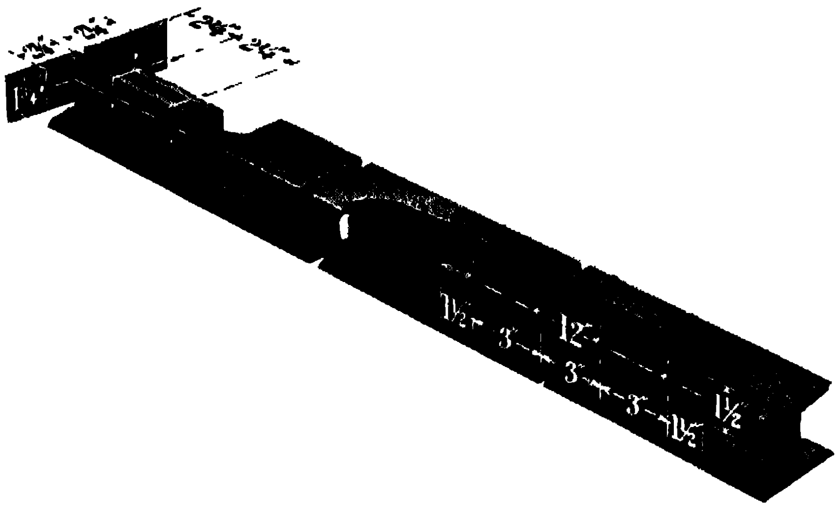
STEEL JOISTS.	MIN. SPAN.	MAX. LOAD.
4¾" x 1¾" x 6½ LBS.	2 FEET.	4 TONS.
4" x 3" x 9½ "	2 "	4 "
4" x 1¾" x 5 "	2 "	3 "

ANGLE CLEATS. 6" x 3½" x ½" x 2½". HOLES. 11/16" DIAMETER.

FISHPLATES. 2½" x 12" x ½". BOLTS OR RIVETS. ⅝" DIAMETER.

END ANGLES AND FISHPLATES.

STANDARD DETAILS.



STEEL JOISTS.

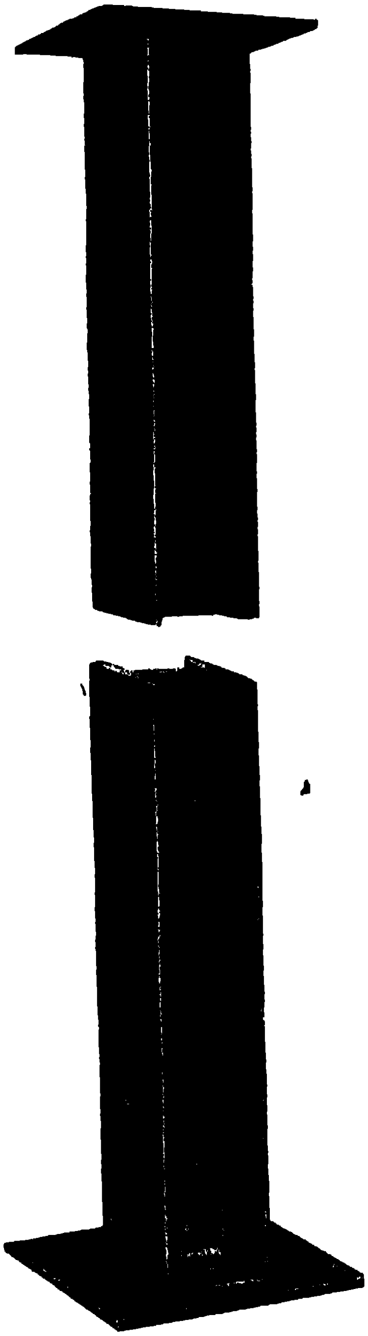
Steel Joists.	Min. Span.	Max. Load.
3"x 3"x 8½ lbs.	2 Feet.	4 Tons.
3"x 1½"x 4 ,,	1 ,,	3 ,,

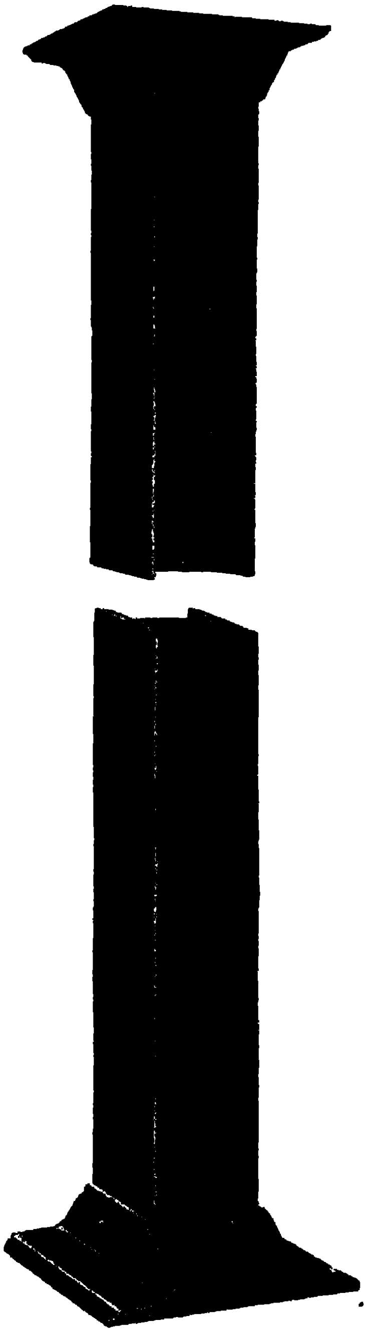
Angle Cleats. 6"x3½"x½"x1¾". Holes. 11/16 Diameter.

Fishplates. 1½"x12"x½". Bolts or Rivets, 5/8" Diameter.

STANCHION CAPS AND BASES.

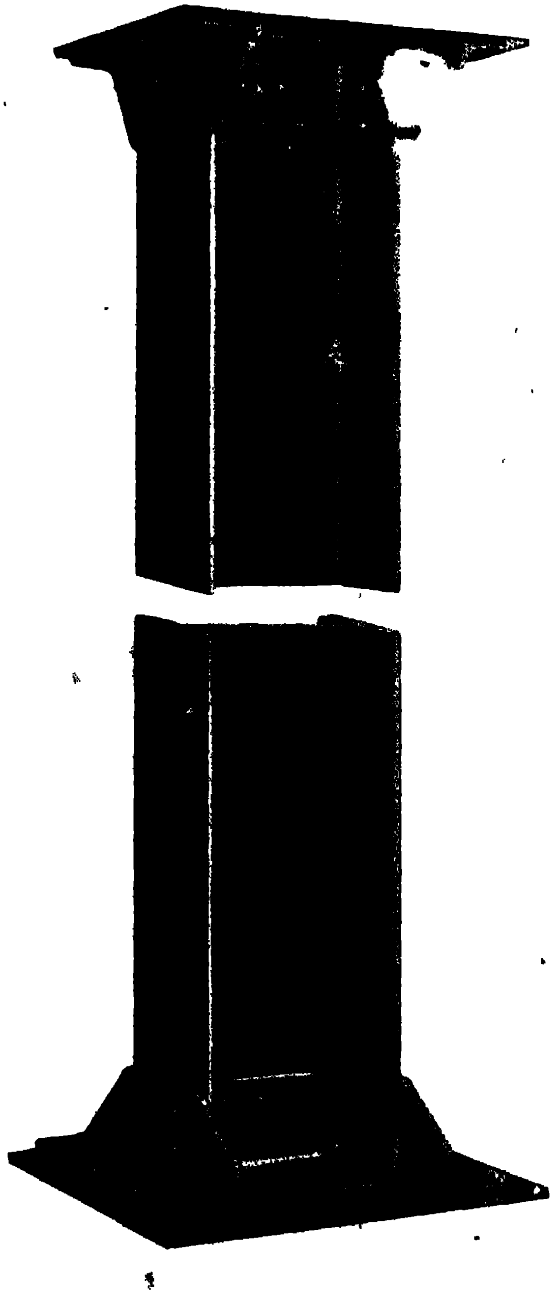
• TYPICAL DETAILS.

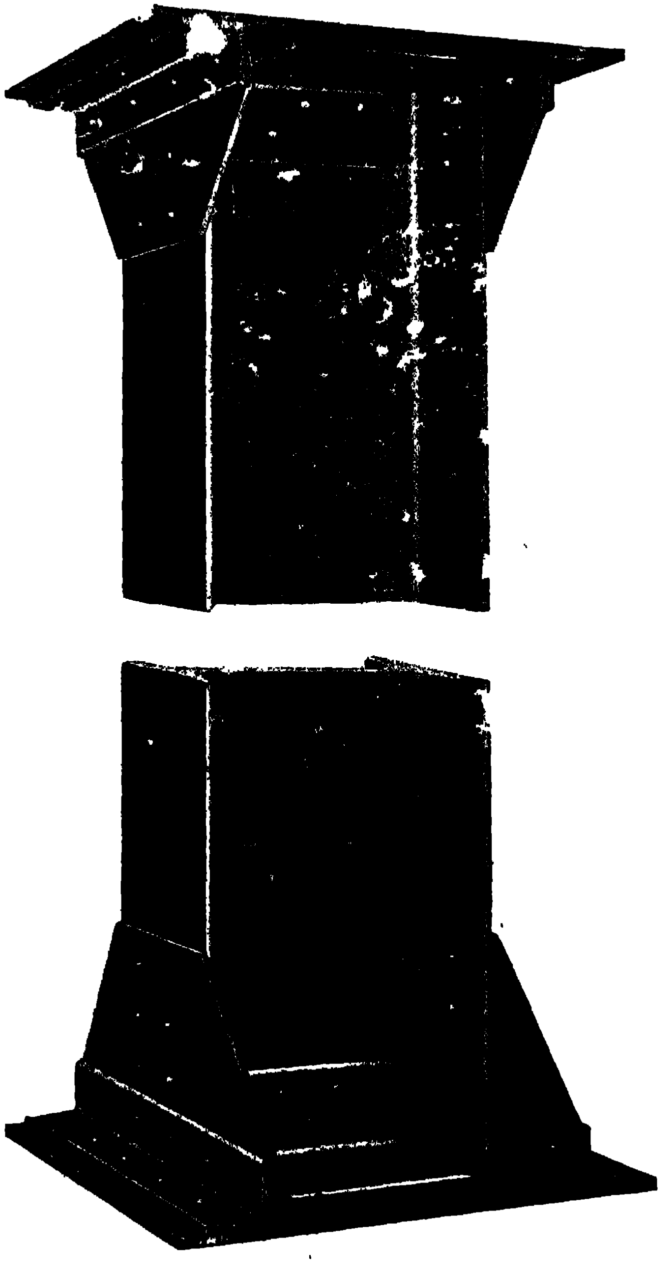




STANCHION CAPS AND BASES.

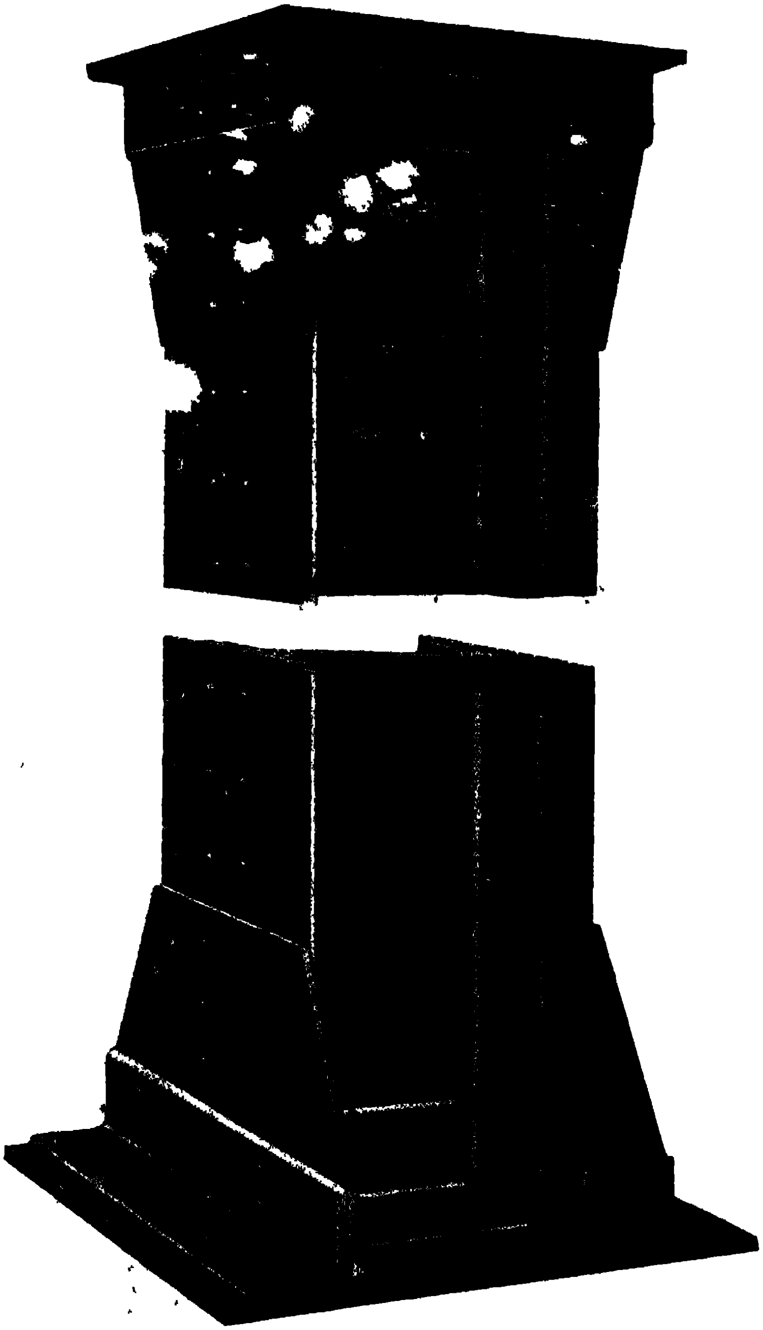
TYPICAL DETAILS.





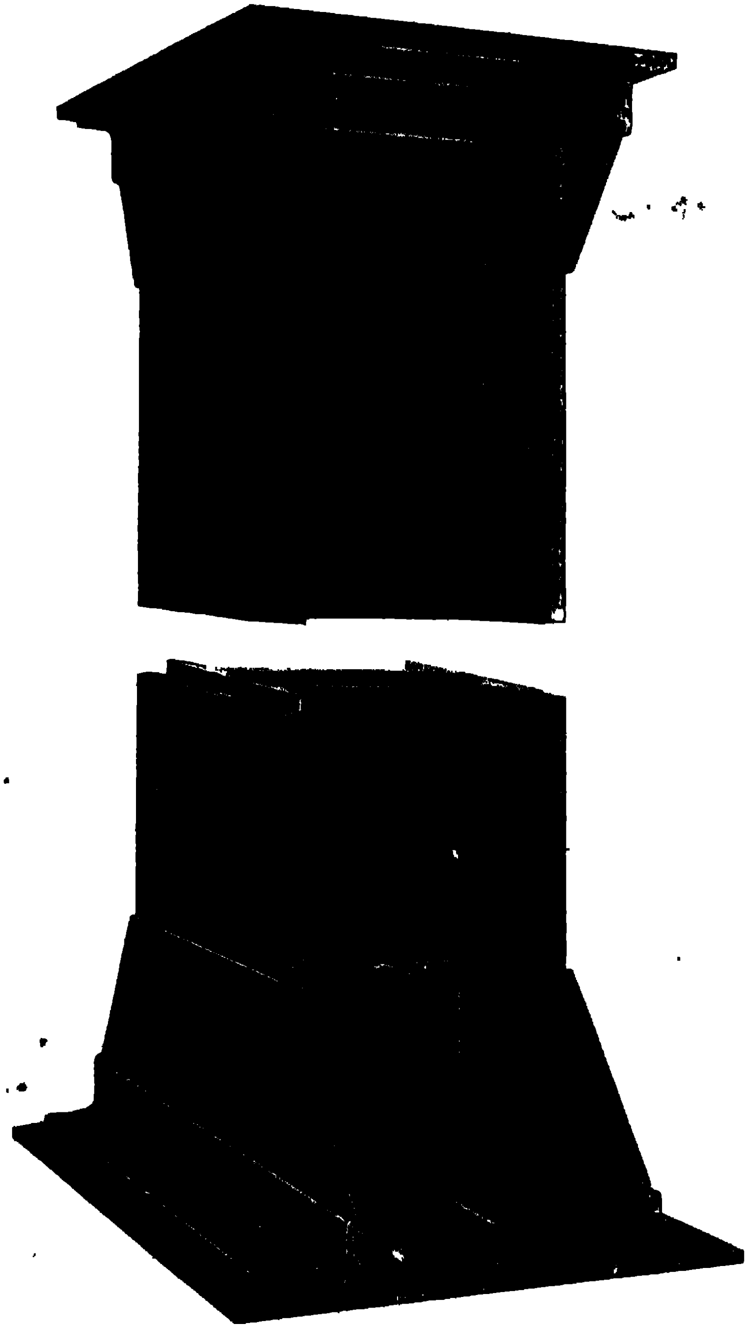
STANCHION CAPS AND BASES.

TYPICAL DETAILS.



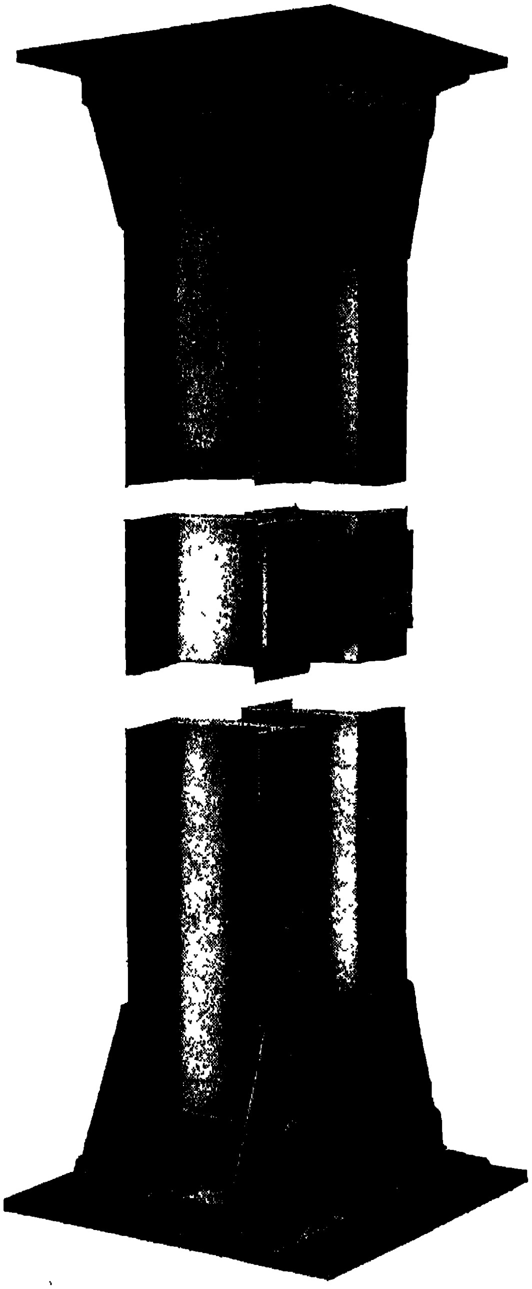
STANCHION CAPS AND BASES.

TYPICAL DETAILS.



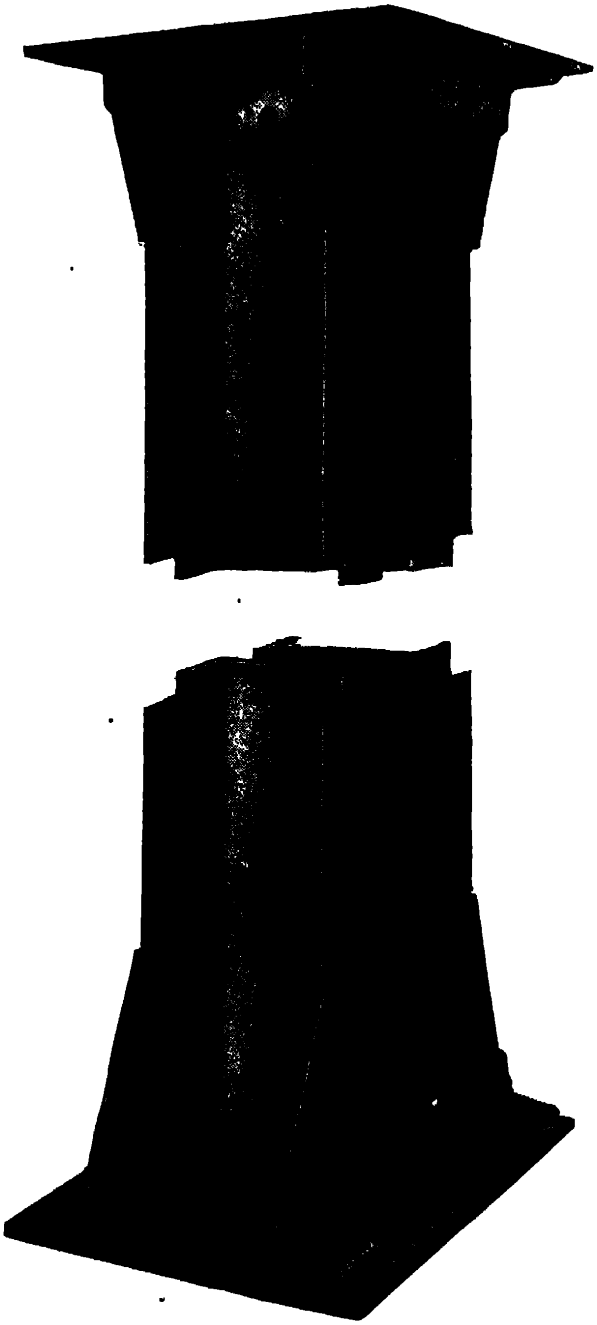
STANCHION CAPS AND BASES.

• TYPICAL DETAILS.



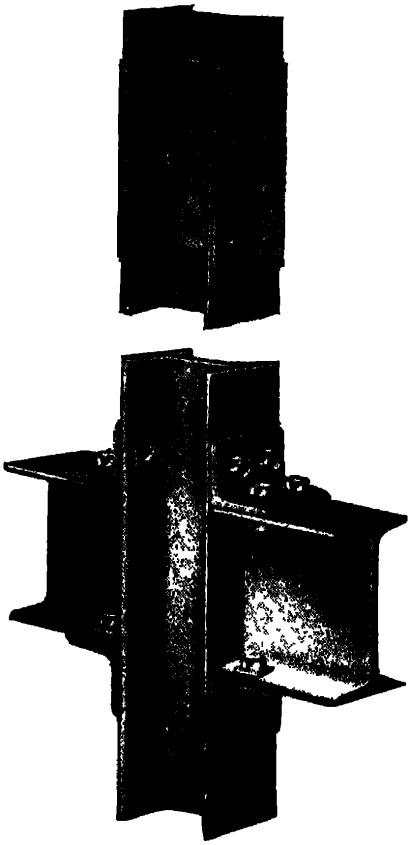
STANCHION CAPS AND BASES.

TYPICAL DETAILS.



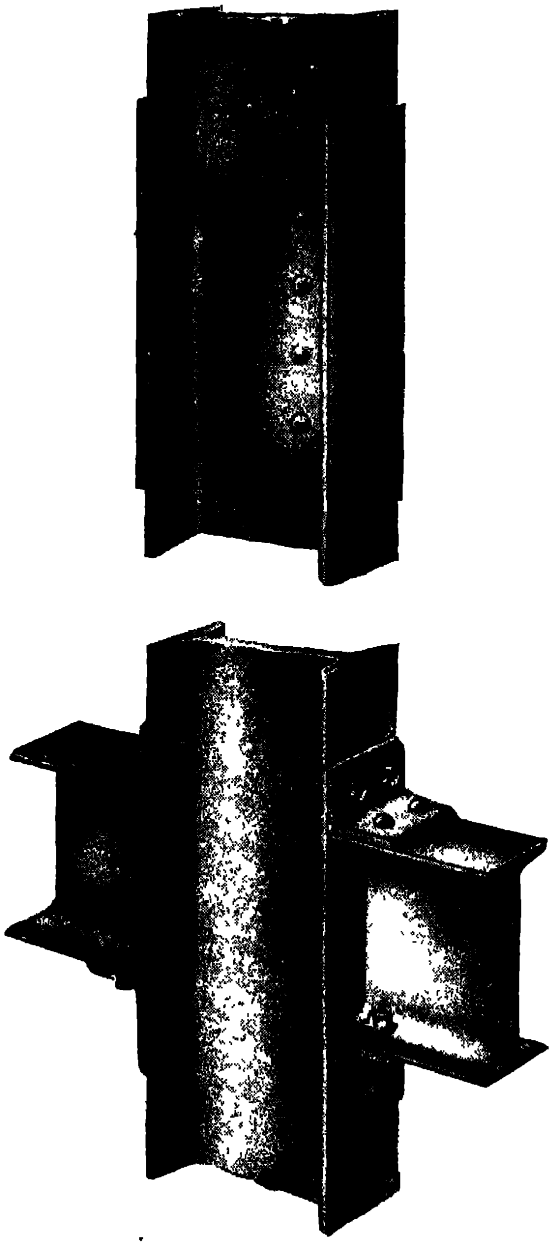
SPLICES AND CONNECTIONS.

TYPICAL DETAILS.



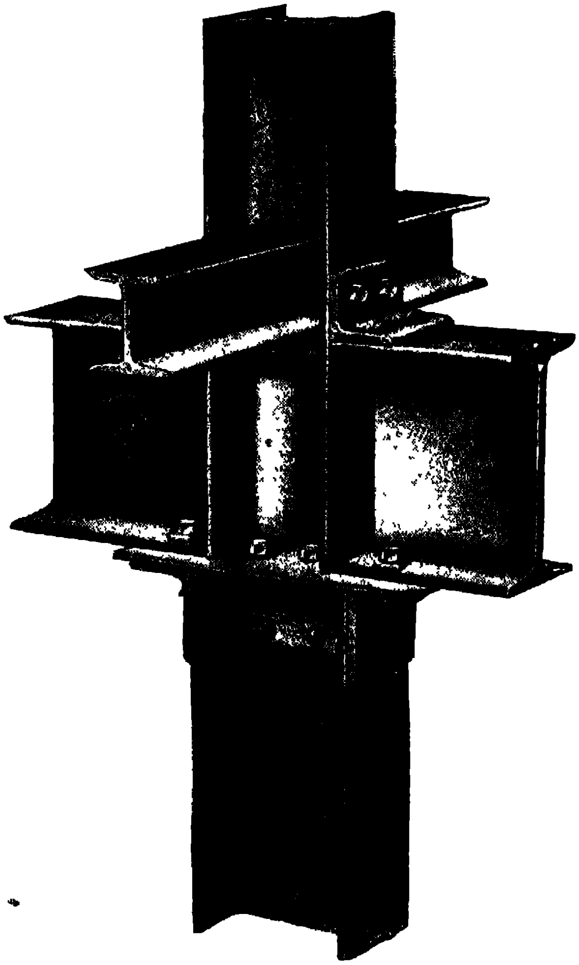
SPLICES AND CONNECTIONS.

TYPICAL DETAILS.



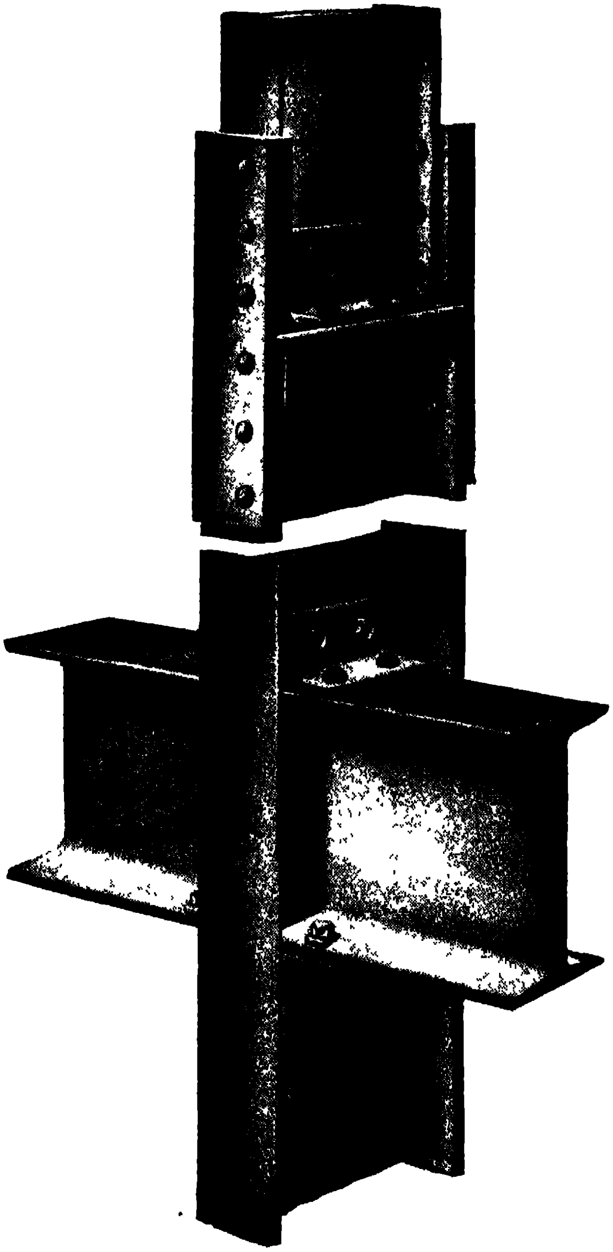
SPLICES AND CONNECTIONS.

TYPICAL DETAILS.



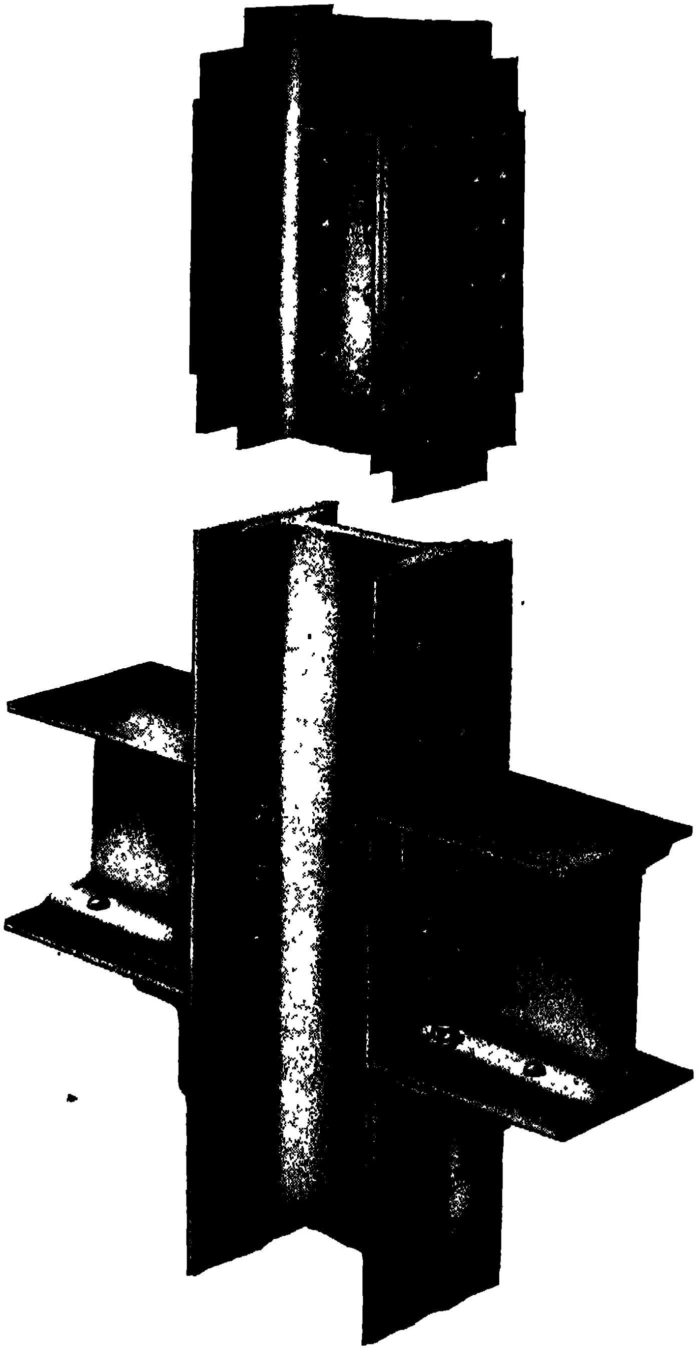
SPLICES AND CONNECTIONS.

TYPICAL DETAILS.



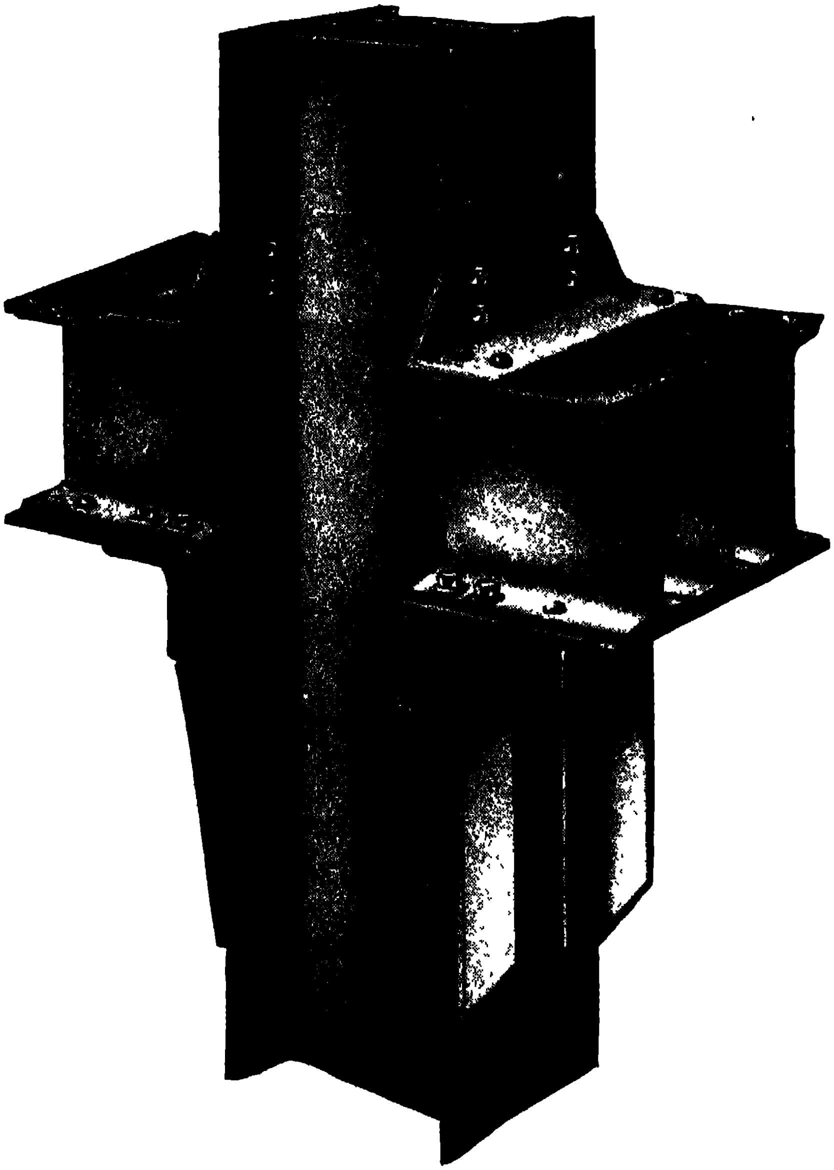
SPLICES AND CONNECTIONS.

TYPICAL DETAILS.



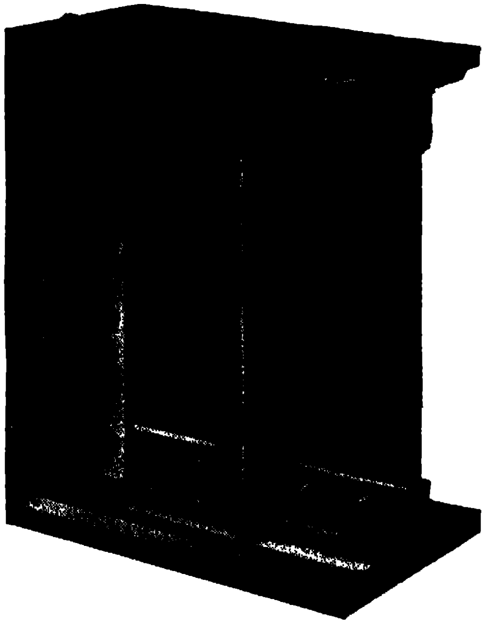
CONNECTION.

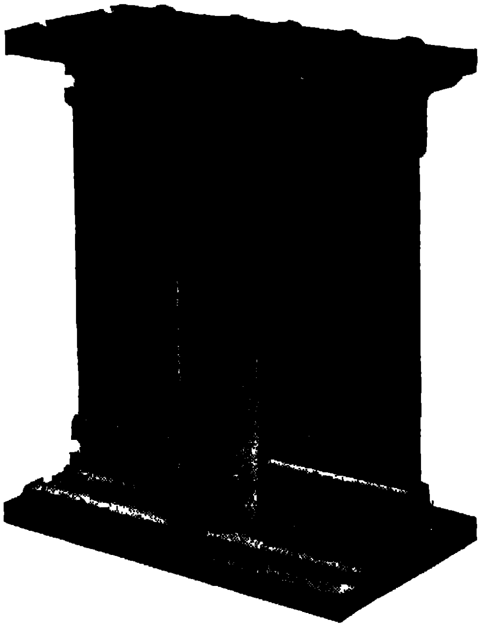
TYPICAL DETAIL.

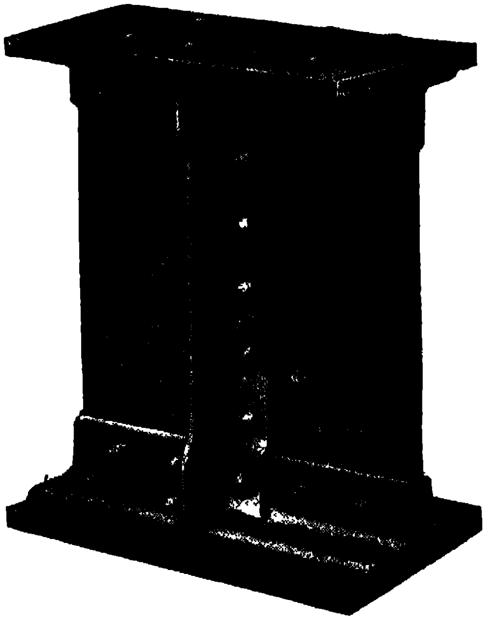


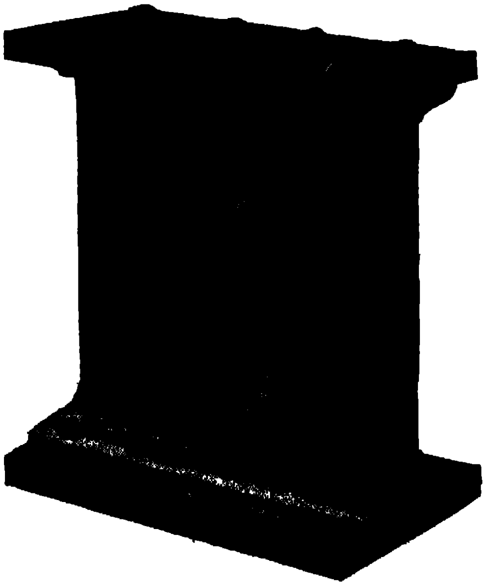
STIFFENERS.

•TYPICAL DETAILS.

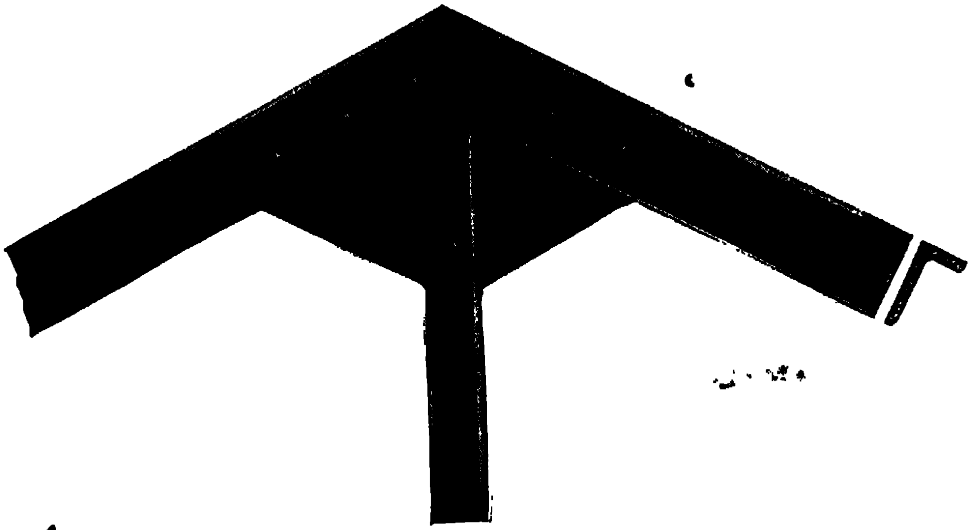




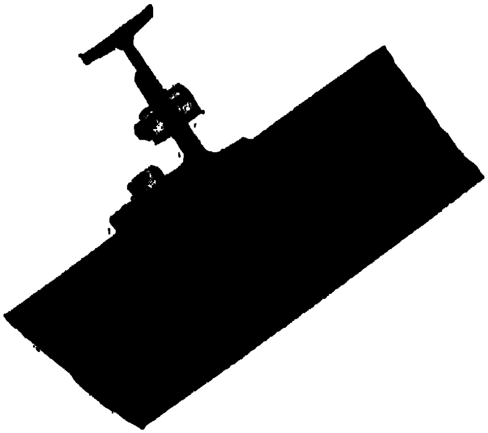




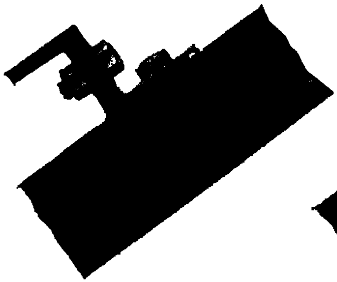
ROOF DETAILS.



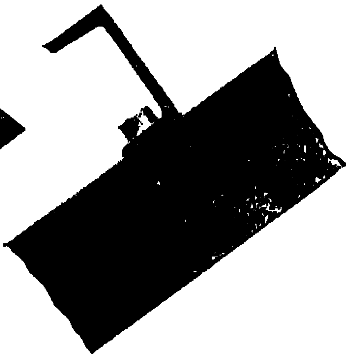
APEX.



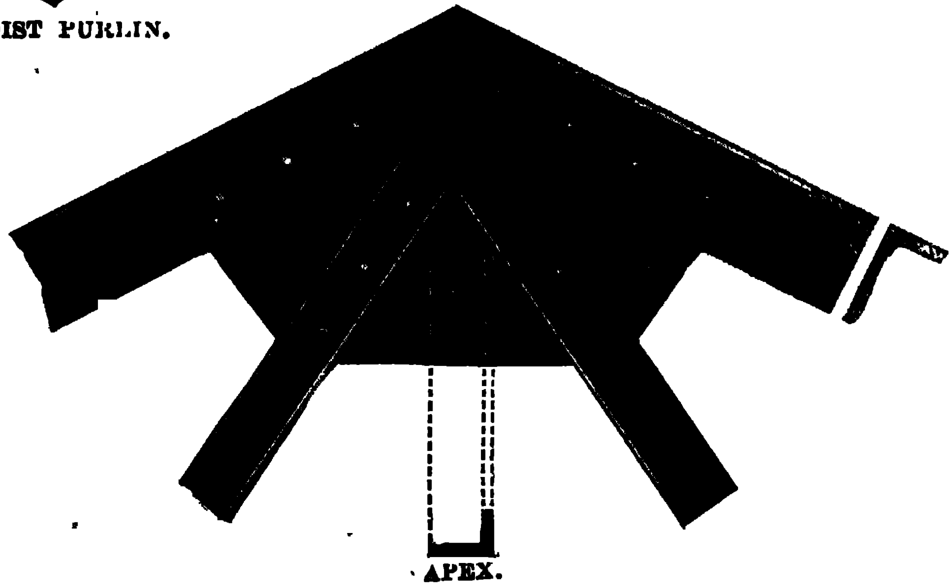
JOIST PURLIN.



ANGLE PURLIN.

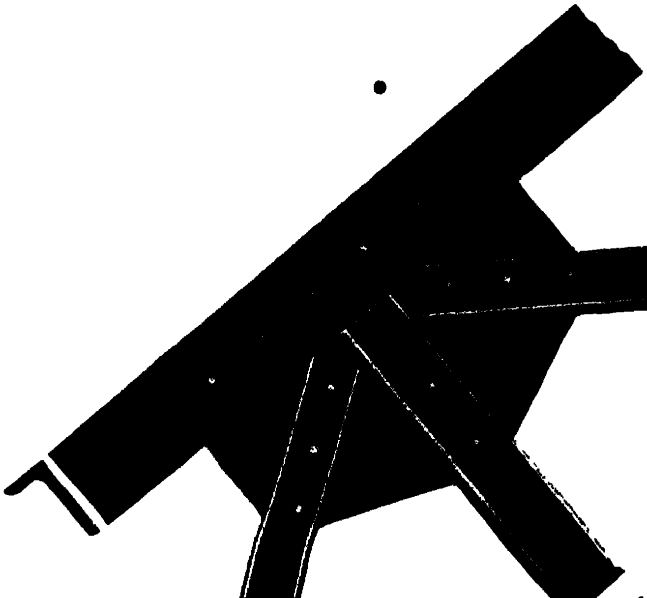


CHANNEL PURLIN.

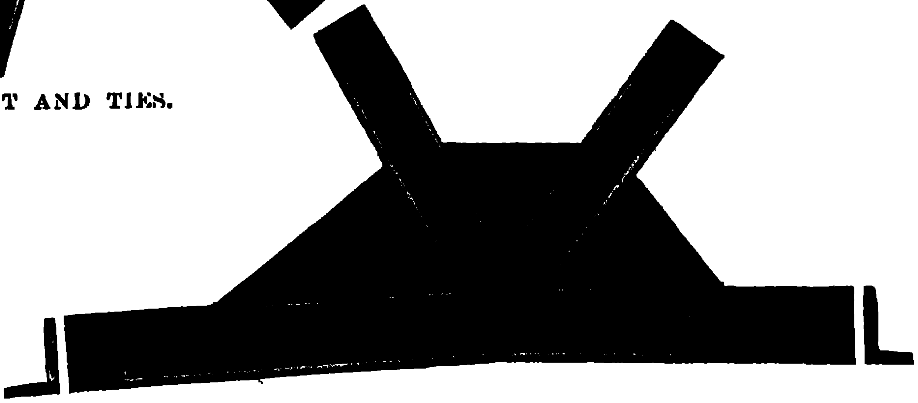


APEX.

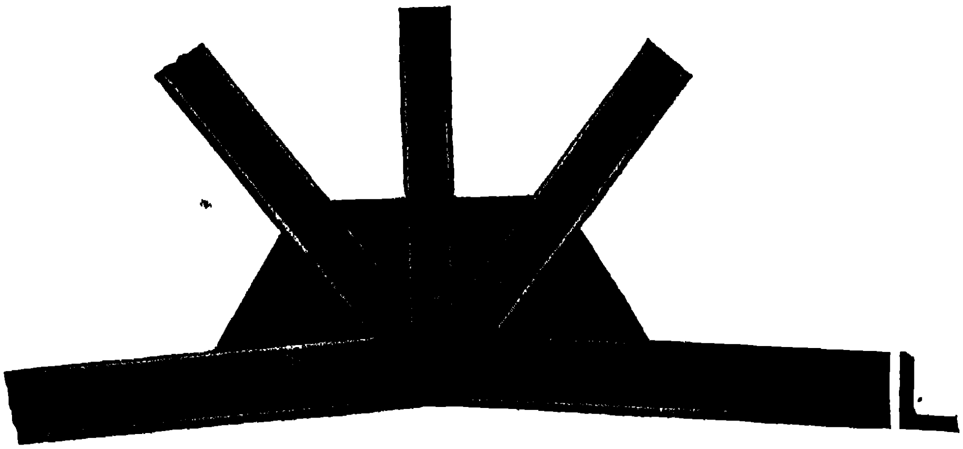
ROOF DETAILS.



RAFTER STRUT AND TIES.

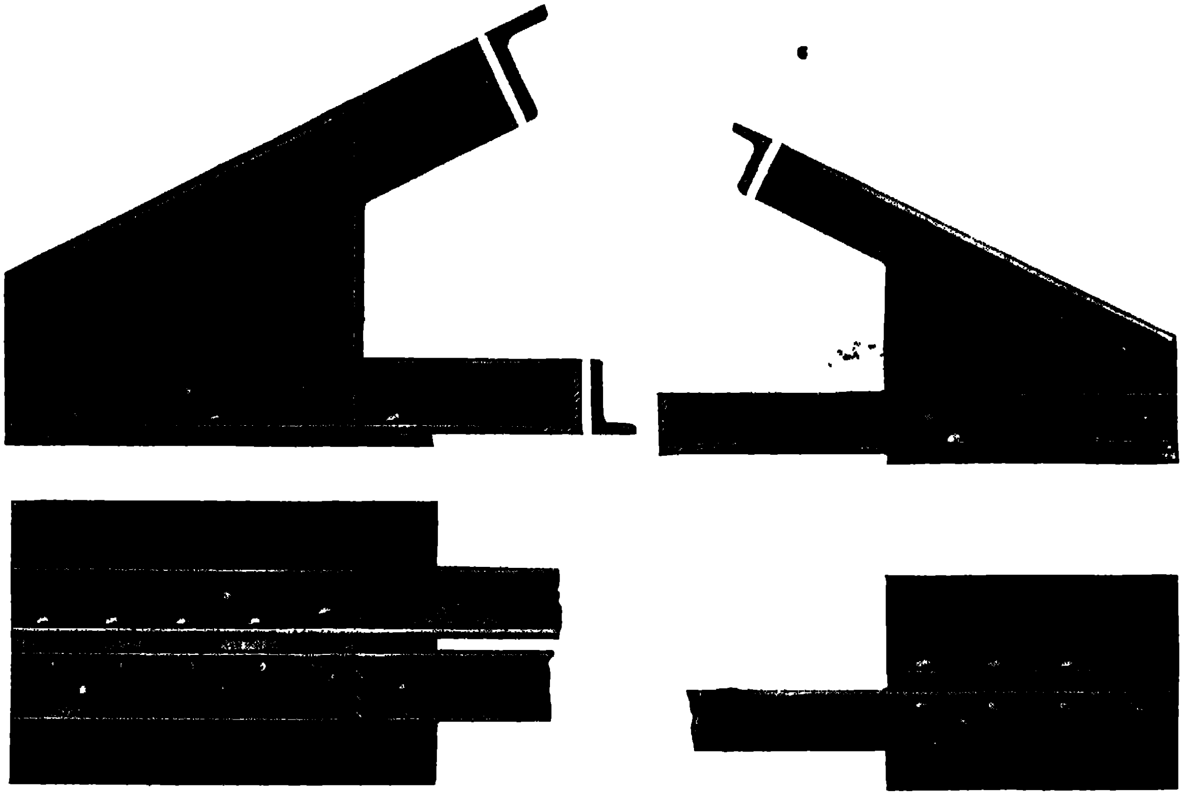


MAIN TIES, STRUT AND DIAGONAL TIE.

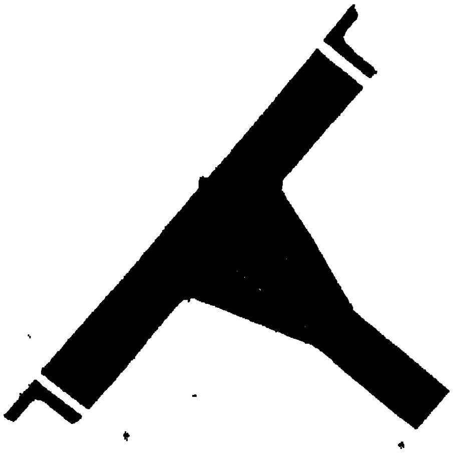


MAIN TIES, STRUTS AND KING TIE.

ROOF DETAILS.



SHOES.



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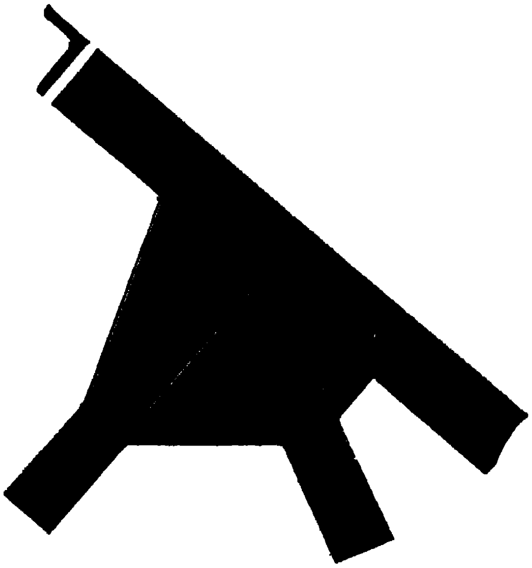

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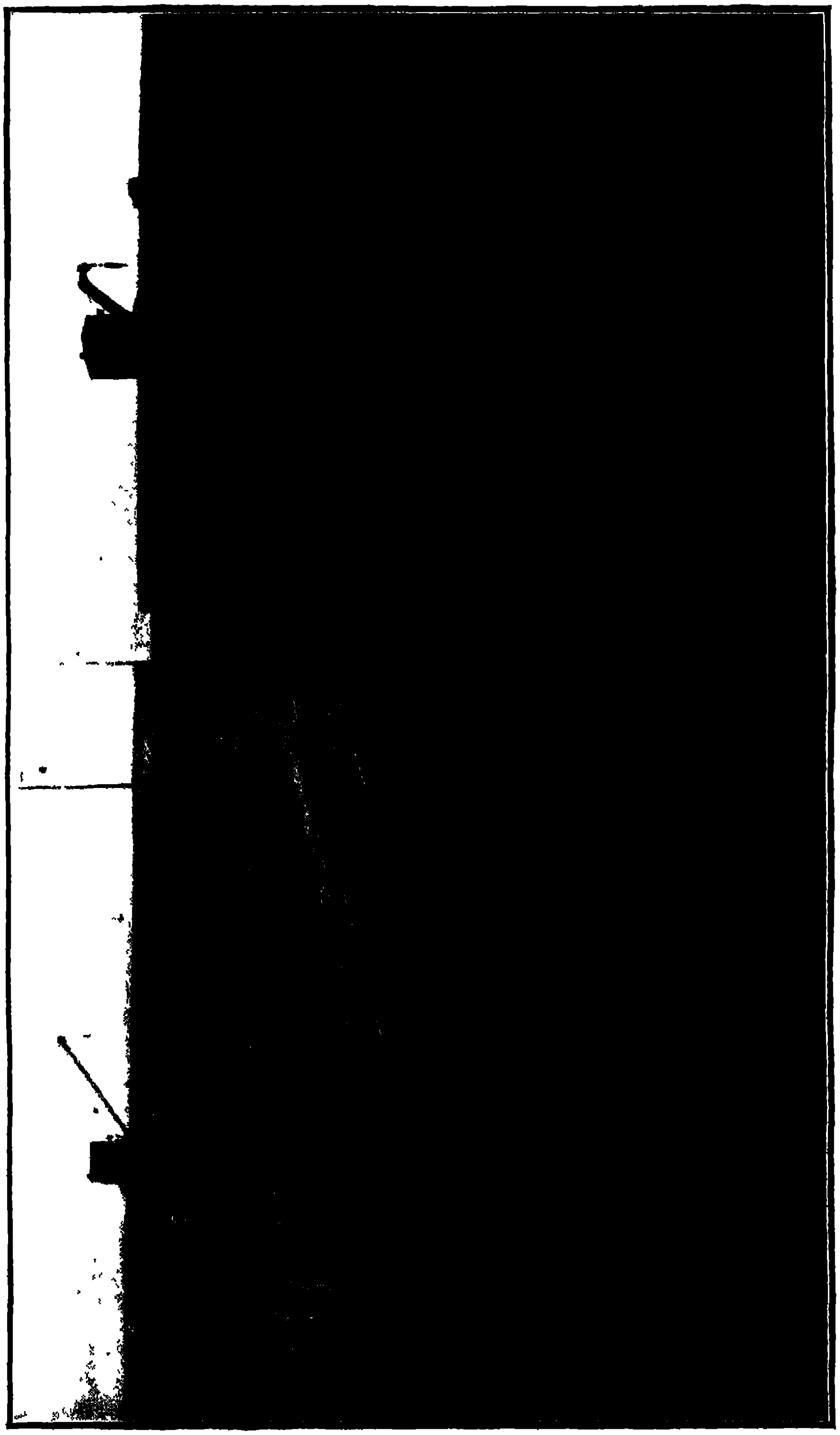

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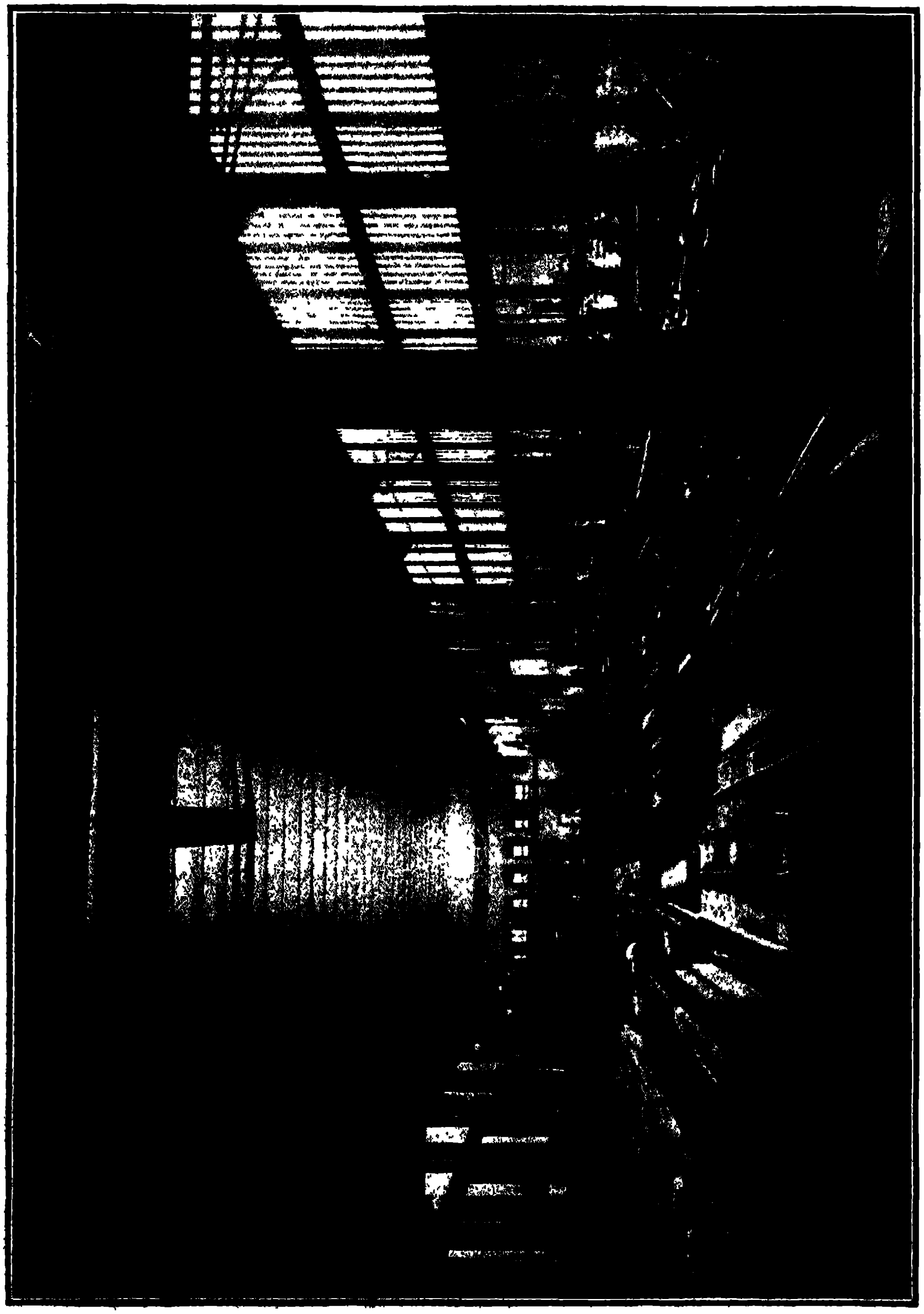

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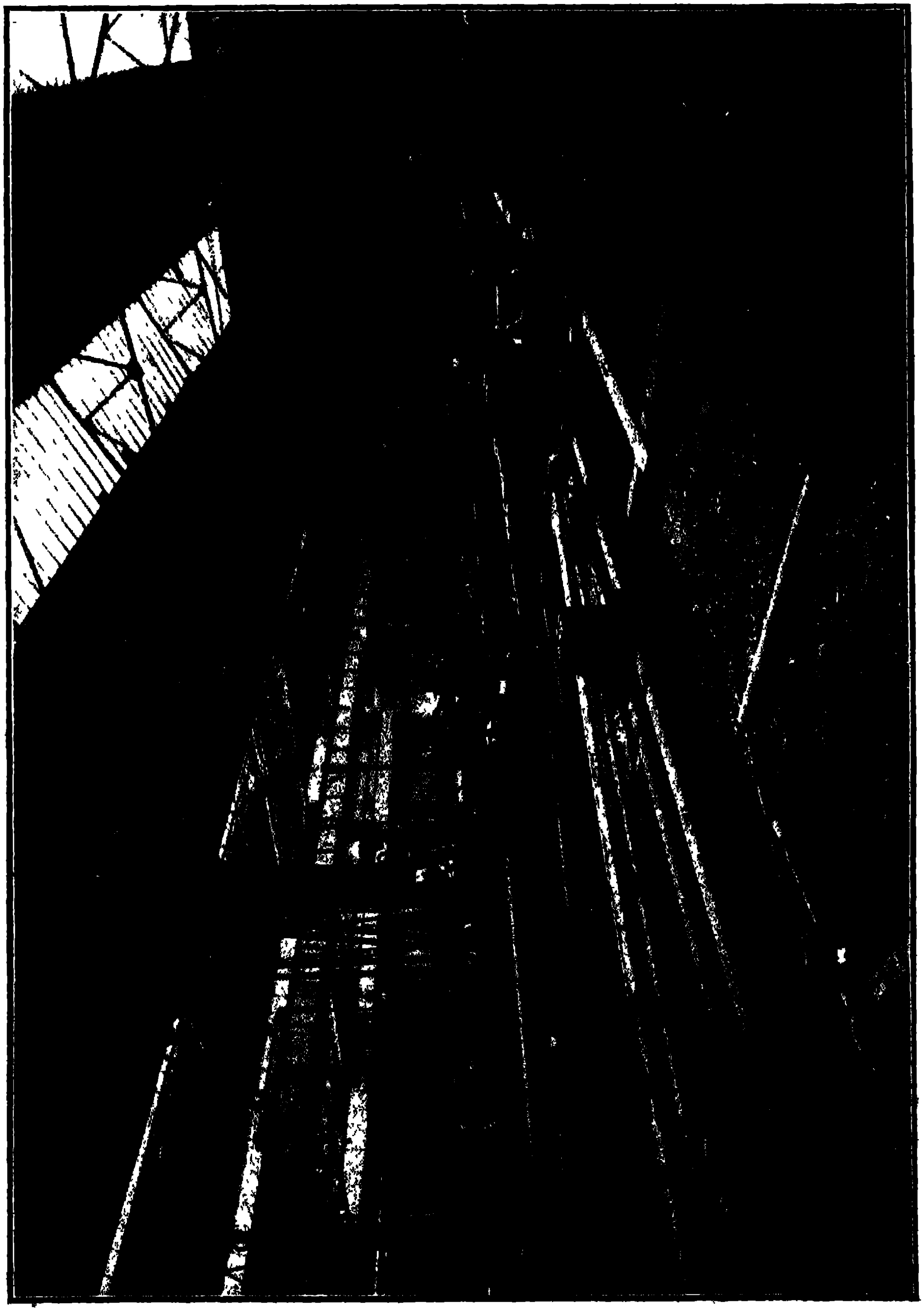

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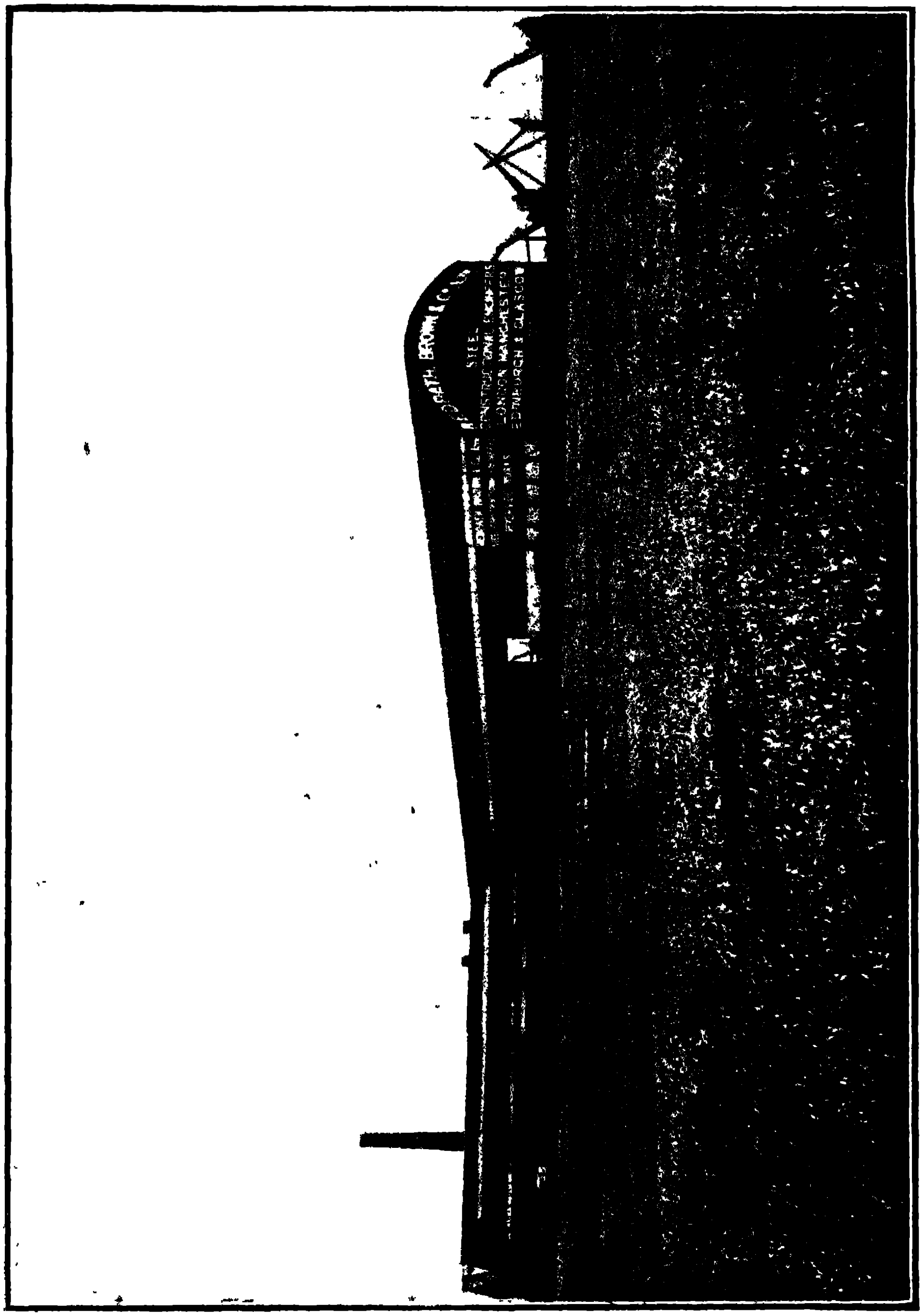


General View of One of the Works.

INDEX.

		PAGE
Preface,	1913 Edition,	5-11
Part I.,	Beams,	13-117
" II.,	Stanchions,	119-210
" III.,	Roofs,	211-231
" IV.,	General Information,	233-387
" V.,	Details,	389-436

A

		PAGE
Abbreviations used in metric system,	IV.	373
Accidental eccentricity, note on,	II.	204-205
Admiralty tests,		6-7
Alignment Chart for normal wind pressure,	III.	227-228
stanchions, safe loads,	II.	201
" " unital stresses,	II.	200
Allowances—		
girders, compound, areas of rivet holes in,	I.	112
" " , weights of rivet heads in,	I.	112
lengths, in cutting to,		8
rolling margin,		7
stanchions, compound, areas of rivet holes in,	II.	195
" " , weights of rivet heads in,	II.	194
Angle of inclination of lattice bars,	II.	137, 139, 155
Angle and Plate Girders, tables of,	I.	75-79
See also GIRDERS.		
Angles—		
beams, notes on as,	I.	111, 113, 114
" , tables of as,	I.	80-81
dimensions of,	V.	396-399
end connections for joists, perspective drawings,	V.	403-416
flanges added, areas of,	IV.	318
" " , weights of,	IV.	319
position of central axes in,	V.	396-399
purlins and side framing, footnotes on as,	I.	80-89
spacing of holes in,	V.	396-399
stanchions, tables of as,	II.	160-167
" , compound, tables of as,	II.	168-183
" , notes on as,	II.	193, 195, 206
" , batten plates for,	II.	180-181, 192
stock, lengths of in,		8
" sections of in,	I.	80-81

PAGE

Antilogarithms, tables of, IV. 334-335
, explanations of, IV. 365
Application, centre of, eccentric loading, II. 196
Applications of—
alignment charts, stanchions, II. 207-210
" " , wind pressure, III. 228-229
coefficients, deflection, beams, II. 266-270
" , eccentricity, stanchions, II. 207-210
" , length, roof members, III. 229
" , stress, " " III. 229
formulæ for centre of application, IV. 280-282
" " deflection, IV. 266-270
" " equivalent tabular loads, IV. 256
" " steel grillage foundations, IV. 291-293
" " web buckling, IV. 274
" " weight of purlins and roof covering, III. 228
" " " " roof truss (approximate), III. 228
loads on one foot span, I. 114-115
mathematical tables, IV. 364-368
moments of resistance, girders, I. 109-110
radii of gyration, stanchions, II. 207-210
tables of Part I., IV. 252 *et seq.*
" " " II., II. 207-210; IV. 279 *et seq.*
" " girders in descending order, I. 109-110
" " joists in concrete, I. 107
" " rivet pitch, I. 50, 53, 56, 59
Approximation, degree of, for tabular loads, 10
Areas—
angles, flanges added, IV. 318
circles, IV. 362-363
deductions from, for rivet holes, I. 112
flat rolled edge steel, IV. 320
square and round steel, IV. 324
tabular, definition of, I. 112; II. 194
See also TABLES, Parts I. *and* II.
Arm of eccentricity, definition of, II. 205
, direction of, II. 206
Arrangement of contents, notes on, I. 9, 108; II. 192
Asphalte for roof covering, III. 224
Axes *and* Axis—
asymmetrical, definition of, IV. 245
" , note on, II. 206
central and neutral, definition of, IV. 245
" " " , note on, IV. 245
" " " , position of in angle compound stanchions, II. 169-179
" " " , " " " compound sections, IV. 304, 306
" " " , " " " standard, V. 392-401
" " " , " " " unsymmetrical girders, V. 402

Axes *and* **Axis**—(*continued*). PAGE
principal, definition of, IV. 245
" , note on, II. 205
relative to tabulated properties, notes on, I. 113-114; II. 194-195
symmetry of, definition of, IV. 245
Axial coefficients, notes on, II. 205-206
reference letters, note on, I. 114

B

Bases for stanchions, solid round steel, diagrams of, II. 188, 190
, " " " , sizes of slabs in stock, II. 189, 191
, typical details of. V. 417-422
, weight of, note on, II. 194
Basis weight of steel used in calculations, 7
Batten plates, note on, II. 192
, proportions and spacing of, on angle compound stanchions, II. 181
, " " " " , " channel " " II. 155
, " " " " , " joist " " II. 137, 139
See also Lattice bars.
Bearing plates, formula for thickness of, IV. 278
, notes on, IV. 278
Bearing values of rivets and bolts, IV. 308-309
Beams—
For reference marks, dimensions, safe loads *and* properties, *see* TABLES, Part I.
bearing plates for, notes and formulæ, IV. 278
bending moments in, diagrams and formulæ, IV. 258-263
" " " , notes on, IV. 244, 257, 264
broad flange, sections of in stock, 11
concrete and steel joists combined, notes and formulæ, I. 107, 110
" " " " " , tables of, I. 100-106
condition of loading on, general, IV. 248
" for tabulated loads on, IV. 239
considerations affecting the selection of sections, IV. 252
definition of, IV. 241
" " , simple, IV. 242
deflection of, notes and formulæ, IV. 244, 265-271
distribution of stress in, notes on, IV. 242
economical considerations affecting design of, IV. 246-248
end connections to stanchions, typical details, V. 423-428
end reactions of, diagrams and formulæ, IV. 258-263
" " " , notes on, IV. 243
equivalent tabular loads, formulæ for, IV. 253-256
extreme fibres of, notes on, IV. 242
factors of safety for, IV. 253
general formulæ, IV. 303-304

Beams—(*continued*). PAGE
lateral support of, IV. 256-257
laws of equilibrium of, IV. 243
" for strength of, IV. 244-245
modulus of section of, notes and formulæ, IV. 246, 264, 299-304
moment of inertia of, " " " , IV. 245-246, 298-306
moment of resistance of, " " " , IV. 245, 257, 264
neutral axis of, notes on. IV. 242
properties of, notes and formulæ, IV. 239, 299-306
shearing forces in, diagrams and formulæ, IV. 258-263
" " ", notes on, IV. 243-244
standard end angles for perspective drawings, V. 403-416
" fishplates for, " " , V. 403-416
stiffeners for, notes on design of, IV. 274-275
supporting brick walls, notes on, IV. 250-251
variations of the tabular conditions, IV. 253 *et seq.*
web buckling of, notes and formulæ, IV. 271-274
working stresses for, IV. 253
See also Angles, Channels, Girders, Joists *and* Tees.
Bending or flexure, definition of, IV. 241
Bending Moment—
definition of, IV. 244
diagrams and formulæ, IV. 258-263
general formulæ, IV. 303-304
maximum, position of, IV. 244
" " ", in overhead travelling crane girders, IV. 295
minimum, position of, IV. 244
notes and formulæ, IV. 244, 257, 264
in stanchions eccentrically loaded, IV. 282-283
" " latticed, IV. 285, 287
" steel grillage foundations, IV. 293
Bolts, Lewis, sizes of, IV. 312
, shearing and bearing values of, IV. 308-309
, Whitworth standard, dimensions of, IV. 312
, " " , weights of, IV. 310-311
Both ends fixed, flat or round. *See* Conditions of ends.
Box plate girders, tables of, I. 78-79
See also Girders, box plate.
Bracing on latticed stanchions. *See* Lattice bars.
Brackets for stanchions, notes on, IV. 283
, perspective drawings of, V. 417-428
Breadth of compression flange, ratio of, to span, I. 111
flange plates, variations of, I. 114
Breaking loads, angles and tees as beams, I. 80-99
See also Leads.
Bridge rails, lengths of in stock, 6
, sections of, IV. 328

PAGE

- British Engineering Standards Committee. *See* Engineering.
  - and metric equivalents, IV. 372-387
  - standard specification, 7
  - weights and measures, IV. 372, 374
- Broad flange beams, sections of in stock, 11
- Buckling web. *See* Web buckling.

C

- Capacity, British measure of, IV. 374
  - , carrying, girders in order of, I. 60-67
  - , metric measure of, IV. 375
- Caps for stanchions, perspective drawings of, V. 417-422
  - , of solid round steel, notes and formulæ, IV. 284
  - , " " " " , stock sizes of, II. 189-191
- Carrying capacity, girders in order of, I. 60-67
- Cast iron separators, sizes and weights of, IV. 317
  - , weight of per cubic foot, IV. 251
- Ceilings, plaster, note on deflection of, I. 116
  - , weight of, III. 224
- Central axis *or* axes. *See* Axes.
- Centre of application of eccentric load systems, note on, II. 196
  - " " " " " formulæ for location of, IV. 280-282
  - gravity, position of in standard sections, V. 392-401
  - " , " " " unsymmetrical compound girders, V. 402
- Centres of component members, notes on, II. 195-196
  - *See also* Tables, Part II.
  - holes. *See* Holes.
  - rivets. *See* Rivets.
- Channel compound girders, tables of, I. 74-75
  - stanchions, tables of, II. 154-159
  - *See also* Girders *and* Stanchions.
- Channels—
  - beams, notes on as, I. 111, 113-114
  - " , tables of as, I. 70-73
  - dimensions of, V. 394-395
  - net moments of inertia of, IV. 325
  - position of central axes in, V. 394-395
  - spacing of holes in flanges of, V. 394-395
  - stanchions, notes on as, II. 194, 206
  - " , tables of as, II. 150-153
  - stock, lengths of in, 6
  - " , sections of in, I. 70-73
  - zig-zag lines of tables, explanations of, I. 115-116; II. 204
- Charts, alignment for normal wind pressure, III. 227
  - stanchions, II. 200-201
- Circles, areas of advancing by ⅛ ths, IV. 362-363
  - , circumferences of, advancing by ⅛ ths, IV. 360-361

PAGE
Circumferences of circles, advancing by ⅛ ths, - - - - - IV. 360-361
Clear span, definition of, - - - - - - - - - - - I. 110-111
See also Span.

Coefficients—
deflection, for beams, applications of, - - - - - IV. 266, 268-270
" , " " , derivation of, - - - - - - - - IV. 265
" , " " , notes and formulæ, - - - - - - - I. 116-117
See also Tables, Part I.
eccentricity, for stanchions, applications of, - - - - II. 207-210
" , " " , derivation of, - - - - - IV. 282, 283
" , " " , notes and formulæ, - - II. 205-210
See also Tables, Part II.
length and stress, for roof members, applications of, - III. 221-222, 228-229
" " " , " " " , derivation of, - - - - III. 220
" " " , " " " , notes and formulæ, - III. 221-222
See also Tables, Part III.

Columns—
solid round steel, bases and caps, diagram of, - - II. 188, 190
" " " , design of caps for, - - - - - - IV. 284
" " " , lengths of bars in stock for, - - - - - 6
" " " , notes on, - - - - - - - - - - II. 193, 195
" " " , sizes of slabs in stock for, - - - - II. 189, 191
" " " , tables of, - - - - - - - - - - II. 188-191
See also Stanchions.
Committee, British Engineering Standards. See Engineering.
Component members of stanchions, centres of, notes on, - - - II. 195-196
See also Tables, Part II.
normal, of wind pressure, Alignment Chart, - - - - III. 227
" , " " " , notes and formulæ, - - III. 226
Composition of compound girders, note on, - - - - - - - I. 112
sections. See Tables, Parts I. and II.
stanchions, note on, - - - - - - - II. 193
Compound girders. See Girders, compound.
stanchions. See Stanchions, compound.
Compression, concrete in, safe working stress for, - - - - - I. 100
Concentric loads. See Loads concentric.
Concrete and steel combined, notes on, - - - - - - - - - I. 110
, safe working stress for, - - - - I. 100
, tables of, - - - - - - - I. 100-107
Conditions, basis, for tabulated results, - - - - - - - - IV. 239
, of ends of stanchions, - - - - - II. 197, 199, 203-204
See also Tables, Part II.
, of support of beams, note on, - - - - - - - - I. 111
See also Tables, Part I.
, relative to stock materials and orders, - - - - - 6-8
, " " tabulated results, - - - - - - - - IV. 239
, tabular, variations of, - - - - - - - - IV. 253-256

PAGE

Conductor pipes for rainwater, notes on proportions of, III. 230-231
Connections, beams to stanchions, typical details, perspective drawings, V. 423-428
  , end angles for joists, V. 403-416
  , fish plates* „ „ V. 403-416
Contents, notes on arrangement of, 9
  of Part I., I. 108
  of Part II., II. 192
Continuous spans, angles and tees as purlins over, I. 80-99
Corrugated sheeting, galvanised, sizes and weights of, IV. 316
Cosecants, natural, IV. 342-343, 367
Cosines, natural, IV. 338-339, 367
Cotangents, natural, IV. 346-347, 367
Coupling boxes, hexagon, sizes and weights of, IV. 313
Coverings, roof, weights of, III. 224
Cranes, overhead travelling, notes on, IV. 293-298
  , particulars and weights of, IV. 298
Cubes of numbers, IV. 354-357
  and fractional parts, IV. 358-359
Cubic foot, weight of steel per, 7
  measure, British, IV. 374
  „ , metric, IV. 375
Curtailment of flange-plates, diagram, IV. 277
  , notes on, IV. 276-277
Curves, Moncrieff stanchion formulæ, II. 198
Cutting to lengths, 8

D

Dead load, total on roof truss, III. 222
Decimal equivalents of fractions of one inch, IV. 369
  one foot for each $\frac{1}{64}$th inch, IV. 370-371
Decrease in distances of component members, notes on, II. 195-196
  widths of flange plates, notes on, I. 114-115
Definition—
  area, I. 112; II. 194
  arm of eccentricity, II. 205
  axial coefficients, II. 205
  both ends fixed, II. 203-204
  „ „ flat, II. 203-204
  eccentric loading, II. 204-205
  fundamental terms of statics, IV. 240-246
  limiting heights, II. 196
  principal axes, II. 205
  ratio of slenderness, II. 196
  spans, I. 110-111
  standard thicknesses, I. 112
  tabular loads on beams, I. 110-111
  „ „ „ latticed stanchions, II. 192-193
  „ „ „ stanchions, II. 195-196

PAGE

- **Deflection—**
  - beams supporting brick walls, permitted ratios of, IV. 271
  - definition of, IV. 244
  - formulæ, IV. 258-263
  - maximum, position of, IV. 244
  - notes, formulæ and applications, I. 116-117; IV. 265-271
  - plastered ceilings, note on, I. 116
  - zig-zag lines, explanation of, I. 116
- Deflection coefficients. *See* Coefficients.
- **Deformation—**
  - definition of, IV. 241
  - elastic, definition of, IV. 241
  - permanent set, definition of, IV. 241
  - ratio of, to stress, IV. 241
  - substituted for strain, IV. 240
  - unital, definition of, IV. 241
- Depth of beams, economical, notes on, I. 109; IV. 247
  - , ratios of to span, notes, formulæ and applications, I. 116; IV. 267
  - , restricted and unrestricted, notes, formulæ and applications, IV. 268-270
- Details. *See* Part V.
- Diameter of rivets in compound sections. *See* Tables, Parts I. *and* II.
- Dimensions of sections. *See* Tables, Parts I. *and* II.
  - " , units of, I. 111
  - standard sections, V. 392-401
- Distances between component members, II. 137-149, 155, 159
  - from neutral axis to extreme fibres, II. 151-153, 161-179, 185-187; V. 392-402
- Distributed loads *See* Loads.
  - *See also* Tables, Part I.
- Downpipes and gutters, diagram for proportioning, III. 231
  - , notes on, III. 230
- Duchemin's formulæ, alignment chart for, III. 227
  - , for normal wind pressure, III. 226

E

- Eccentric loading, centre of application of, IV. 280-282
  - , general formula, IV. 282-283
  - , notes on, II. 192, 193, 204-210
  - *See also* Loads.
- Eccentricity, accidental, note on, II. 204-205
  - , coefficients. *See* Coefficients.
- Economical considerations in design of steelwork, IV. 246-248
- Economy of compound girders, note on, I. 109
- Effective span of beams, I. 110-111
  - *See also* Span.
- Elastic instability of stanchions, II. 203
  - limit, definition of, IV. 241

PAGE

Elasticity, definition of modulus of, IV. 241
of steel, modulus of, I. 117
Ellipse of inertia, definition of, IV. 245
, reference to, II. 195
Elongation test of steel, 7
Ends of beams, support of, I. 3
See also Tables, Part I.
stanchions, condition of, II. 203-204
See also Tables, Part II.
Engineering Standards Committee—
acknowledgment to, 10
reference marks, I. 16, 18, 70, 72, 80-98
sections recommended by, 6; I. 16, 18, 70, 72, 80-98
specification for structural steel, 7
standard thicknesses, I. 16, 18, 70, 72, 80-98, 112
Equal angles. *See* Angles.
Equilibrium, laws of, IV. 243-245
, of moment of resistance and bending moment, I. 109
Equivalent concentric load value, II. 207
See also Tables, Part II.
tabular loads, notes and formulæ, IV. 253-256
Equivalents, British and metric, IV. 372-387
Establishments of the Company, 4
Examples. *See* Applications.
Experiments on wind pressure, notes on, III. 225
Explanations of tables, Part I., I. 108-117
, Part II., II. 192-210
, Part III., III. 220-224
, Part IV. IV. 364-368
Extreme fibres, definition of, IV. 242
, distances from neutral axes to, II. 151-153, 161-179, 185-187; V. 392-402

F

Factor of safety and working stress, notes on, IV. 253
" " " , table, IV. 253
for angles, footnote on, I. 80-91
" beams, note on, I. 111
See also Tables, Part I.
in Stanchion Formulæ, II. 202-203
Feet and inches to millimetres, IV. 376-377
to metres, IV. 384
Fibres, extreme, definition of, IV. 242
Fishplates, standard, for joists, V. 403-416
Fittings, galvanised corrugated sheet, sizes and weights of, IV. 316
Flange plates, curtailment of, graphic method, IV. 276-277
standard mean thicknesses of, V. 392-395
width, ratio of to span, I. 111

PAGE
Flats, rolled edge steel, areas of, IV. 320
  , stock, lengths of in, 6
  , " , weights of in, IV. 321-323
Flexure, definition of, IV. 241
Floor loads, IV. 249
Foot, cubic, weight of steel per 7
  , decimals of, for each $\frac{1}{64}$th of an inch, IV. 370-371
  , lineal, weights of sections per. *See* Tables, Parts I. *and* II.
Force, external, definition of, IV. 240
  , moment of, definition of, IV. 242
  , positive and negative, definition of, IV. 242
  , shearing, definition of, IV. 243
Formulæ—
  batten plates for compound stanchions, II. 136-139, 154-155, 180-181
  bearing plates for girders, IV. 278
  bending moment, IV. 257-264
  centre of application of eccentric load, IV. 280-281
  deflection, coefficients, I. 116-117
    , notes and applications, IV. 265-271
    See also footnotes, Tables, Part I.
  eccentricity coefficients, II. 207
    See also footnotes, Tables, Part II.
  eccentric loading, general, IV. 282-283
  equivalent tabular load, IV. 253-256
  flexure, general, IV. 302
  " , " , reference to, IV. 303
  joists in concrete, I. 107
  lattice bars, IV. 284-288
  " " and batten plates, II. 136-139, 154-155, 180-181
  modulus of section, IV. 264
  moment of inertia, IV. 299-306
  " " resistance, IV. 257-264
  Moncrieff Stanchion, II. 197-204
  slab caps, IV. 284
  Stanchion, Moncrieff. II. 197-204
  steel grillage foundations, IV. 289-293
  web buckling, IV. 271-274
Foundations—
  loads on, method of calculating, IV. 288
  notes on, IV. 288-293
  safe pressures on, IV. 289
  steel grillage, design of, IV. 289-293
Fractions of an inch expressed in decimals, IV. 369
  to millimetres, IV. 378-379
Framing, side, angles and tees as, footnotes on, I. 80-99
Functions, trigonometrical, IV. 330-331

G

PAGE

Galvanised corrugated sheeting, weight of, III. 224
" sheets, sizes and weights of, IV. 316
fittings, sizes and weights of, IV. 316
Gas tubing, sizes and weights of, IV. 312
Girders—
areas of, note on, I. 112
box plate, tables of, I. 78-79
composition of, notes on, I. 112
compound, arranged in order of strength, application of, I. 109-110
" , " " " " " , tables of, I. 60-67
" , double channel type, note on, I. 110
" , " " " , tables of, I. 74-75
" , " joist " , tables of, I. 30-39
" , economical considerations, I. 109; IV. 246-248
" , range included in tables, notes on, 9; I. 198
" , rivet diameter and pitch. *See* Tables, I. 20-48, 68, 74
" , rivet pitch, applications of tables of, I. 50, 53, 56, 59
" , " " , notes on, I. 108
" , " " , tables of, I. 50-59
" , single joist type, tables of, I. 20-29
" , " " " , unsymmetrical, dimensions of, V. 402
" , " " " , " , note on, I. 110
" , " " " , " , tables of, I. 68-69
" , triple joist type, tables of, I. 40-49
curtailment of flange plates, graphic method, IV. 276-277
flange thicknesses of, note on, I. 112
italics of tables, explanation of, I. 108
" " " , notes on, IV. 275
loads on 1 foot span, application of, I. 114-115
moment of resistance of, notes on, I. 109
plate, note on, I. 110
" , rivet pitch, footnotes on, I. 76, 78
" , tables of, I. 76-77
properties of, notes on, I. 113-114
stiffeners and web buckling, notes and formulæ, I. 115-116; IV. 271-275
weights per foot, note on, I. 112
zig-zag lines on tables, explanations of, I. 115-116
Glass roofing, weight of, III. 224
Grillage foundations, notes, formulæ and applications, IV. 289-293
Gutters and downpipes, diagram for proportioning, III. 231
" , notes on, III. 230
Gyration, radius of. *See* Radius of gyration.

H

Heights, limiting, for stanchions, note on, II. 196
Hook-bolts, galvanised, weight of, IV. 316
Hooke's Law, IV. 241

PAGE
Holes, flange thicknesses at, note on, - - - - - - - - I. 112
, standard spacing of, - - - - - - - - - - V. 392-401
Hurst, on gutters and downpipes, - - - - - - - - III. 230

I

Inch, decimal equivalents of fractions of, - - - - - - - - IV. 369
Inches, and fractions of, to millimetres, - - - - - - - IV. 378-379
Inclination of lattice bars to horizontal, - - - - - II. 137, 139, 155
Inertia—
ellipse of, definition of, - - - - - - - - - - - IV. 245
moment of, bridge rails, - - - - - - - - - - - IV. 328
" ", British and metric conversion factors for, - - IV. 375
" ", compound girders, notes on, - - - - - - - I. 113-114
" ", compound sections, method of calculation, - IV. 304-306
" ", definition of, - - - - - - - - - - IV. 245-246
" ", notes, formulæ and applications, - - - - IV. 298-306
" ", plates at various distances apart, - - - - - IV. 325
" ", rectangles, - - - - - - - - - - - - IV. 326-327
" ", relative axes, notes on, - - - - - - - - - I. 113-114
See also Tables, Part I.
net moment of, channels, - - - - - - - - - - - - IV. 325
" " ", joists, - - - - - - - - - - - - IV. 325
Intentional eccentricity, note on, - - - - - - - - II. 205
See also Eccentricity.
Italics, in tables, explanations of, - - I. 108; II. 196; IV. 367
See also footnotes, Parts I. *and* II.

J

Joist compound girders, tables of, - - - - - - - - - I. 20-69
stanchions, " ", - - - - - - - - - - II. 126-149
See also Girders *and* Stanchions.
Joists—
beams, notes on, as, - - - - - - - - - - - - I. 111, 113-114
" , tables of, as, - - - - - - - - - - - - - I. 16-19
" , in concrete, notes and formulæ, - - - - - - - I. 107, 110
" , " " , tables of, as, - - - - - - - - I. 100-106
dimensions of, - - - - - - - - - - - - - - - V. 392-393
net moment of inertia of, - - - - - - - - - - - - IV. 225
spacing of holes in flanges of, - - - - - - - - - V. 392-393
stanchions, notes on, as, - - - - - - - - - - II. 195, 206
" , tables of, as, - - - - - - - - - - - - II. 122-125
stock, lengths of in, - - - - - - - - - - - - - - 6
" , sections of in, - - - - - - - - - - - - - - I. 16-19
zig-zag lines of tables, explanations of, - - - I. 115-116; II. 204

K

PAGE

Ketchum on gutters and downpipes, III. 230
Kilogrammes to pounds, IV. 387
  per metre to pounds per foot, IV. 387
  per square metre to pounds per square foot. IV. 387
King rod trusses, note on, III. 223

L

Lateral support of beams, notes on, I. 111. IV; 256-257
Lattice bars and batten plates, II. 136-139, 154 155, 181, 192-193
  , various formulæ for, IV. 284-288
Laws of equilibrium, IV. 243-246
  for strength of beams, IV. 244-245
Lead covering for roofs, III. 224
Length coefficients for roof members, III. 221-222
Lengths in stock, range of, 6
  , margins for cutting to, 8
Lewis bolts, sizes of, IV. 312
Linear measure, British, IV. 372
  , metric, IV. 373
Lists, stock, 6
Load, total dead, on roof trusses, III. 222
Loading, eccentric, general formula, IV. 282-283
  , location of centre of application of, IV. 280-282
Loads—
  breaking, note on, I. 111
    „ , on angles and tees as beams, tables of, I. 80-99
  concentric, definition of, II. 196
  dead, IV. 248-252
  distributed, definition of, I. 110
  eccentric, notes on, II. 204-210
  equivalent tabular, notes on, IV. 253-256
  live, IV. 248-252
  maximum on girders, notes on, IV. 275-276
    „ „ beams and girders, notes on, I. 115
  notes on, IV. 248-252
  on beams and girders. *See* Tables, Part I.
    „ floors and roofs, IV. 249-250
    „ foundations, IV. 288
    „ one foot span, application, I. 114-115
    „ „ „ „ , notes on, I. 114-115
    „ stanchions. *See* Tables, Part II.
  overhead travelling crane, IV. 293-298
  safe approximate, on stanchions by alignment chart, II. 200-201
    „ concentric. *See* Tables, Part II.
    „ distributed. *See* Tables, Part I.
    „ on joists in concrete, tables of, I. 100-105
  tabulated, basis conditions of, IV. 239
  tabular, degree of approximation of, 10

PAGE

Location of central axis, compound sections, IV. 304-305
  centre of application of eccentric loading, IV. 280-282
  point of maximum bending moment, IV. 244
  zero point of shear, IV. 244
Logarithms of numbers, tables of, IV. 332-333
  , explanations of, IV. 364-366

M

Margin, rolling, 7
Margins for cutting to specified lengths, 8
Masonry, safe pressures on, IV. 289
  , weights of, IV. 251
Material, definition of, IV. 239
Materials, miscellaneous, weights of, IV. 251-252
  , roofing, weights of, III. 224
Mathematical tables, notes on, IV. 364-368
Measures, British, IV. 372, 374
  , metric, IV. 373, 375
Mensuration, IV. 330
Merriman's formula for weight of roof truss, III. 222
Method of selection. *See* Selection, method of.
Metres to feet, IV. 385
Metric and British equivalents, IV. 372-387
  system, abbreviations for, IV. 373
  " , prefixes in, meaning of, IV. 375
  weights and measures, IV. 373, 375
Millimetres to inches, IV. 380-383
Miscellaneous materials, weights of, IV. 251-252
Modulus of Elasticity, I. 117
  " " , definition of, IV. 241
  of section, British and metric equivalents, IV. 375
  " " , definition of, IV. 246
  " " , maximum. *See* Tables, Part I.
  " " , notes and formulæ, IV. 264
  " " , relative axes, notes on, I. 114
Moment of a force, definition of, IV. 242
  of inertia, definition of, IV. 245-246
  " " , *See* Inertia.
    See also Tables, Part I.
  of resistance, definition of, IV. 245
  " " , notes and formulæ on, I. 60-67; IV. 257-264
    See also Resistance.
Moncrieff Stanchion Formulæ, notes on, II. 197-204

N

National Physical Laboratory, wind experiments, III. 225
Natural cosecants, IV. 342-343
  cosines, IV. 338-339

PAGE

Natural cotangents, IV. 346-347
  secants, IV. 344-345
  sines, IV. 336-337
  tangents, IV. 340-341
Neutral axis, definition of, IV. 242
  See also Axes, neutral.
Normal component of wind pressure, III. 226-227
Notation, dimensions of sections, I. 111; II. 193
  , notes on, IV. 246
Notes, explanatory of the Tables of Part I. I. 108-117
  , " " " " of Part II. II. 192-210
  , " " " " of Part III. III. 220-224
  on use of Mathematical Tables of Part IV. IV. 364-368
Nuts and bolts, Whitworth standard, dimensions of, IV. 312
  , weights of, IV. 310-311

O

Ordered lengths, cutting margins for, 8
Overall dimensions. *See* Dimensions *and* Sizes.

P

Panel lengths, roof, calculation of, III. 229
Parallel joists, notes on, IV. 275
Permanent set, definition of, IV. 241
Photographs of Works, V. 433-436
Pillars. *See* Stanchions.
Pitch of rivets. *See* Rivets.
Plaster ceilings, note on, I. 116; IV. 270
  , weight of, III. 224
Plate girders, tables of, I. 76-79
  See also Girders.
Plates, curtailment of flange, graphic method, IV. 276-277
  , lengths of, in stock, 6
  , tie, on stanchions. *See* Batten plates.
  , at various distances apart, moment of inertia of, IV. 325
Ports, shipping, 6
Position of centre of gravity, V. 392-402
  neutral axis, V. 392-402
Pounds to kilogrammes, IV. 386
  per foot to kilogrammes per metre, IV. 386
  " square foot to kilogrammes per square metre, IV. 386
Prefixes used in metric system, IV. 375
Pressure of wind, normal, on roofs, III. 225
Pressures on foundations and masonry, tables of safe, IV. 289
Principals, roof. *See* Roof *and* Roof trusses.

PAGE

Properties, definition of, IV. 245
, general formulæ, IV. 299-303
, notes on, IV. 239
of compound sections, formulæ, IV. 304-306
" sections, as beams or girders. *See* Tables, Part I.
" " , as stanchions. *See* Tables, Part II.
" " , notes on, 10; I. 112-114; II. 194-195
Proportions of lattice bars and batten plates, II. 136-139, 154-155, 181
Purlins, angles and tees as, footnotes on, I. 80-98
, weight of, III. 222

Q

Quality of steel in stock, 6-7

R

Radius of gyration, definition of, IV. 246
, relative axes, notes on, II. 194
See also Tables, Part II.
Rafters, design of, III. 223
Rails, bridge, lengths of in stock, 6
, properties of, IV. 328
Ratio of deflection to span, IV. 267
" " " " , note on, I. 116
See also footnotes, Tables, Part I.
of slenderness, definition of, II. 196
Reactions, definition of, IV. 240
, example of calculation of, IV. 262-263
, formulæ for, IV. 258-263
of roofs, III. 220
, rules for, IV. 243
Rectangles, moment of inertia of, IV. 326-327
Reeled pitch of rivets, diagrams of, I. 50, 53, 56, 59
See also Rivets.
Reference marks of Engineering Standards Committee, I. 16-18, 70-72, 80-98
See also Tables, Parts I. *and* II.
Resistance, moment of, I. 60 67
, definition of, IV. 245
, note on, I. 109
, notes and formulæ, IV. 257-264
Rivet holes, deductions for, I. 113-114; II. 195
, " " , in properties, IV. 306
, diameters of, V. 392-401
, flange thicknesses at, I. 112
, positions of, V. 392-401
Rivet pitch for compound girders, note on, I. 108
See also footnotes, Tables, Part I.

PAGE

Rivet pitch for compound stanchions, note on, II. 194
, notes on, IV. 275-276
tables, I. 50-59
Rivet pitches, diagrams of, I. 50, 53, 56, 59
spacing, notes on, IV. 276
Riveting, hand and machine, allowance for, IV. 315
Rivets, diameters of for compound girders. *See* Tables, Part I.
, „ „ „ „ stanchions. *See* Tables, Part II.
, galvanised, weights of, IV. 316
, shearing and bearing values of, IV. 309
, weights of, IV. 314
Rolled edge flats, lengths of in stock, 6
Rolling margin, 7

Roof—
coverings, approximate weights of, III. 224
details, V. 430-432
diagrams, explanations of, III. 223
loads, IV. 250
members, details of, V. 430-432
„ , stress and length coefficients, III. 220-221
rafters, III. 223
trusses, design of, III. 223
„ , explanation of tables, III. 220-224
„ , King rod, note on, III. 223
„ , ridged, types of, III. 214-219
„ , total dead load on, III. 222
„ , „ wind pressure on, III. 222
„ , weight of, by Merriman, III. 222
Roofing screws, galvanised, weights of, IV. 316
Roots, square, of numbers, IV. 350-353
Round and square steel, areas and weights of, IV. 324
Rounds, lengths of in stock, 6
, solid steel, as stanchions, caps, notes and formulæ, IV. 284
, „ „ „ „ , diagrams of caps and bases, II. 188, 190
, „ „ „ „ , notes on, II. 193, 195
, „ „ „ „ , sizes of caps and bases in stock II. 189, 191
, „ „ „ „ , tables of, II. 188-191

S

Safe loads. *See* Loads.
stress. *See* Stress.
Secants, natural, IV. 344-345
Section, modulus of. *See* Modulus of section.

Sections—
compound, properties of, IV. 304-306
diagrams of. *See* Tables, Parts I. *and* II.
minimum, used in roof design, III. 229

Sections—(*continued* PAGE
notation of, I. 111. II. 193
selection of, notes on, IV. 252-276
standard, dimensions of, V. 392-401
See also Tables, Parts I. *and* II.
units of dimensions of, I. 111. II. 193
Selection of compound girders, method of, I. 60-67, 109
sections, notes on, IV. 252-276
Separators, cast iron, notes on, IV. 275
sizes and weights of, IV. 317
Set, permanent, definition of, IV. 241
Shear, formulæ, IV. 258-263
, location of zero point, IV. 244
Shearing force, vertical, definition of, IV. 243
value of rivets and bolts, IV. 308-309
Sheets, galvanised corrugated, fittings for, sizes and weights of, IV. 316
, sizes and weights of, IV. 316
Shipping ports, 6
Sines, natural, IV. 336-337
Sizes of slabs in stock, II. 189-191
overall, units of, I. 111. II. 193
See also Tables, Parts I. *and* II.
Sketches. *See* Diagrams.
Slabs, sizes of, in stock, II. 189, 191
Slates, roofing, weights of, III. 224
Slenderness, ratio of, definition of, II. 196
Solid steel rounds. *See* Rounds.
Solution of triangles, IV. 331
Spacing of holes in flanges, V. 392-401
lattice bars and batten plates. *See* Lattice bars.
rivets, notes on, IV. 276
Spans, continuous, angles and tees over, footnote on, I. 80-99
, effective, note on, I. 110-111
, maximum, for deflection, note on, I. 116
See also Tables, Part I.
, minimum, for various rivet pitches, tables of, I. 50-59
, " , " web buckling, note on, I. 115
, " , notes on, IV. 275-276
See also Tables, Part I.
Specifications, British Standard, for structural steel, 7
, gutters and downpipes, III. 230
, lattice bars and batten plates, II. 137, 139, 155, 181
Specified lengths, cutting to, margin for, 8
Splices of stanchions, typical details of, perspective drawings, V. 423-427
Square and round steel, areas and weights of, IV. 324
centimetres to square inches, IV. 385
feet to square centimetres, IV. 384

PAGE

Square inches to square centimetres, IV. 384
  measure, British, IV. 374
  " , metric, IV. 375
  metres to square feet, IV. 385
  roots of numbers, IV. 350-353

Squares of numbers, IV. 348-349

Stanchion, definition of, IV. 242

Stanchions—
  alignment charts for, II. 200-201
  angle and tee in buildings, note on, II. 193
  angle, tables of, II. 160-167
  areas of, note on, II. 194
  arm of eccentricity, definition of, II. 205
  batten plates on, proportions and spacing of, II. 136-139, 154-155, 180-181, 192-193
  brackets on, note on, IV. 283
  channel, tables of, II. 150-153
  compound, composition of, notes on, II. 193
    " , double angle types, tables of, II. 168-183
    " , " channel types, tables of, II. 154-159
    " , " joist types, tables of, II. 136-149
    " , rivet pitch, notes on, II. 194
    " , spacing of component members, notes on, II. 195-196
  concentric and eccentric loading combined, note on, II. 210
  concentric loading, definition of, II. 196
  condition of ends of, notes on, II. 197-204
  connections of beams to, perspective drawings, V. 423-428
  details of, typical, perspective drawings, V. 417-428
  eccentric loading on, notes on, II. 204-210; IV. 280-284
  flat ended, definition of, II. 204
  Formulæ, Moncrieff, notes on, II. 197-204
  foundations for, calculation of loads on, IV. 288
  italics of tables, explanations of, II. 196
  joists, tables of, II. 122-125
  latticed, various formulæ for, IV. 284-288
  latticing on, proportions and spacing of, II. 136-139, 154-155, 180-181, 192-193
  limiting heights of, II. 196
  ratio of slenderness of, notes on, II. 196
  safe loads on, tables of. *See* Part II.
  solid round steel, notes on, II. 193; IV. 284
    " " " , tables of, II. 188-191
  stresses, working unital, tables of and notes, II. 198-200
  tee, tables of, II. 184-187
  variations of tabular conditions, notes on, IV. 279
  weights per foot of, notes on, II. 194
  zig-zag lines of tables, explanations of, II. 204

PAGE

Standard angle connections for joists, perspective drawings, V. 403-416
    dimensions of sections, V. 392-401
    fishplates for joists, perspective drawings, V. 403-416
    rivet pitch, girders, I. 108
    " " , stanchions, II. 194
    sections, dimensions of, V. 392-401
    spacing of holes, V. 392-401
    thicknesses, I. 17, 19, 71, 73; V. 392-401
        See also Thicknesses.
Standards Engineering Committee. *See* Engineering.
Static load, definition of, IV. 240
Statics, fundamental definitions in, IV. 240-246
Steel, structural, modulus of elasticity of, I. 117
    , quality of in stock, 6-7
    , standard specification for, 7
    , test elongation of, 7
    , ultimate strength of, 7
    , weight of, basis, 7
Stiffeners, details of, perspective drawings, V. 429
    , notes on, I. 115; IV. 274, 275
Stock, lengths of sections in, 5-6
    , lists of, 6
    , quality of steel in, 6-7
    , range of sections in, 5-6
    , sections in, angles, I. 80-91
    , " " , broad flange beams, 11
    , " " , channels, I. 70-73
    , " " , joists, I. 17, 19
    , " " , tees, I. 93-99
    , sizes of slabs for solid round stanchions, II. 189, 191
Strain, note on, IV. 240
Strength of beams, laws for, IV. 244-245
    , girders arranged in descending order of, I. 60-67
    , increases per cent. in, for joists in concrete, I. 106-107
    , ultimate, definition of, IV. 240
    , ultimate tensile, of steel in stock, 7
Stress coefficients for roof members, III. 214-219, 220-221
    , definition of, IV. 240
    , distribution of, IV. 242
    , extreme fibre, definition of, IV. 240
    , total in roof member, III. 221
    , ultimate tensile, note on, I. 111
    , unit, definition of, IV. 240
    , unital, definition of, IV. 240
Stresses in beams, note on, I. 111
    , safe unital, for stanchions, II. 198-201
    , " working, for beams. *See* footnotes, Tables, Part I.
    , working and factors of safety, table of, IV. 253

Strut. *See* Stanchion. PAGE
Support of beams, conditions of, - - - - - - - - - I. 111
, lateral, notes on, - - - - - - - - IV 256-257
Surveying measure, - - - - - - - - - - - - IV. 372

T

Tables. *See* Contents *to each* Part.
See also particular headings of.
Tangents, natural, - - - - - - - - - - - - IV. 340-341
Tees—
beams, notes on as, - - - - - - - - - - - I. 111, 113-114
" , tables of as, - - - - - - - - - - - - I. 92-99
dimensions of, - - - - - - - - - - - - - V. 400-401
position of central axes in, - - - - - - - - - - V. 400-401
purlins and sideframing, footnotes on as, - - - - - - I. 92-99
spacing of holes in, - - - - - - - - - - - - V. 400-401
stanchions, notes on as, - - - - - - - - - - II. 193-195, 206
" , tables of as, - - - - - - - - - - - II. 184-187
stock, lengths of in, - - - - - - - - - - - - 6
" , sections of in, - - - - - - - - - - - - I. 92-99
Tensile strength, ultimate, - - - - - - - - - - - 7
Tests, - - - - - - - - - - - - - - - - 6-7
Thicknesses, batten plates, - - - - - - - - II. 137, 139, 155, 181
, bearing plates, notes and formula, - - - - - - IV. 278
, flange at rivet holes, note on, - - - - - - I. 113
, lattice bars, - - - - - - - - - - II. 137, 139, 155, 181
, slab caps, notes and formula,- - - - - - - - IV. 284
, standard, angles, channels, joists and tees, - - - V. 392-401
Triangles, solution of, - - - - - - - - - - - - IV. 331
Trigonometrical functions, - - - - - - - - - - - IV. 330-331
Trusses. *See* Roof trusses.
Tubing, gas, sizes and weights of, - - - - - - - - - IV. 312
Types of roof trusses, - - - - - - - - - - - - III. 214-219
truss connections, - - - - - - - - - - V. 430-432

U

Ultimate strength, definition of, - - - - - - - - - - IV. 240
stress, definition of, - - - - - - - - - - - IV. 240
tensile strength, - - - - - - - - - - - - 7
Unequal angles. *See* Angles.
Uniformly distributed loads. *See* Loads.
Unit stress, definition of, - - - - - - - - - - - - IV. 240
Unital deformation, definition of, - - - - - - - - - - IV. 241
stress, definition of, - - - - - - - - - - - IV. 240
stresses, stanchions, - - - - - - - - - - - II. 198-201
Units of dimensions, - - - - - - - - - - - I. 111; II. 193

V

PAGE

Values, shearing and bearing, of bolts and rivets, IV. 308-309
Velocity of wind in relation to pressure, III. 225
Vertical shear, definition of, IV. 243

W

Walls, brick, beams supporting, notes on, IV. 271
  , weights of, IV. 250-251
Washers, galvanised, weights of, IV. 316
  , ordinary, weights of, IV. 313
  , square bevelled, weights of, IV. 313
Web buckling, note on, I. 115
  , notes, formulæ and examples, IV. 271-275
  , tables for, IV. 272-273
Webs, centres of and distances between, notes on, II. 195-196
  , " " joist compound stanchions, II. 137-149
  , distances between channel compound stanchions, II. 155-159
  , standard thicknesses of, V. 392-395
Weight of purlins, III. 222, 224
  roof truss, Merriman's formula for, III. 222
  steel as basis for calculations, 7
Weights—
  approximate, of roof coverings, III. 224
  and measures, British, IV. 372, 374
  " " , metric, IV. 373, 375
  of angles, flanges added, IV. 319
  " bridge rails, IV. 328
  " flat rolled steel, IV. 321-323
  " galvanised corrugated sheets, IV. 316
  " " hook bolts, IV. 316
  " " rivets, IV. 316
  " " roofing screws, IV. 316
  " " sheet fittings, IV. 316
  " " sheeting bolts, IV. 316
  " " washers, IV. 316
  " materials, IV. 251-252
  " overhead travelling cranes, IV. 294
  " rivets, cup headed, IV. 314
  " square and round steel, IV. 324
  " " bevelled washers, IV. 313
  " tubing, gas, IV. 312
  " Whitworth Standard bolts and nuts, IV. 310-311
  per foot, allowances, I. 112; II. 194
  " " , rolling margin, 7
  See Tables, Parts I. *and* II.
Whitworth Standard bolts and nuts, dimensions of, IV. 312
  , weights of, IV. 310-311

PAGE
Width of compression flange, ratio of, to span, - - - - - I. 111
Wind pressure, normal, - - - - - - - - - - - - - III. 225
, " , alignment, chart, - - - - - - - - III. 227
, " , Duchemin's formula, - - - - - - - III. 226
, **relation to velocity,** - - - - - - - - - III. 225
, **total on one truss,** - - - - - - - - - III. 222
Working stress. *See* Stress.
Works, photographs of, - - - - - - - - - - - - V. 433-436

Y

Young's modulus, definition of, - - - - - - - - - - IV. 241
, **for steel,** - - - - - - - - - - - IV. 241
See also Modulus of Elasticity.

Z

Zero point shear, location of, - - - - - - - - IV. 243-244
Zig-zag lines, explanations of, - - - - - - I. 115-116; II. 204

For 1909 Amendment of London Building Acts (see page xix L.)

PART VI
(LONDON)

STANCHIONS.

SAFE LOADS
in accordance with the
L.C.C. (General Powers) Act, 1908

AND

PROPERTIES,

Etc.

CONTENTS OF PART VI.

PAGE
Steel Joists as Stanchions, - 123 L

Compound Steel Stanchions –

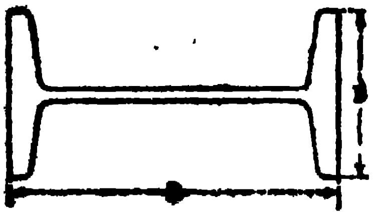
Single Joist Type, - 126 L
Two Joists Latticed, - - - - 136 L
Double Joist Type, - - - - 140 L
Steel Channels as Stanchions, - - 150 L

Compound Steel Stanchions –

Two Channels Latticed - 154 L
Double Channel Type 156 L
Steel Angles as Stanchions, 160 L

Compound Steel Stanchions or Struts

Two Equal Angles, Back to Back, - - - 168 L
Two Unequal " " " - - - 172 L
Two Equal Angles Battened, - - 180 L
Steel Tees as Stanchions, - - - - - 184 L
Solid Round Steel Columns, - - - - 188 L
Explanations of Tables, - - 192 L
Amendment of London Building Acts, - - - - 211 L



STANCHIONS.

Steel Joists.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		8	9	10	11	12	13	14	16	18	20	22	24
30 J	24 × 7½	144	138	132	126	120	115	109	97·5	85·8	74·1		
29 J	20 × 7½	129	124	119	114	109	104	99·0	88·9	78·7	68·6		
28 J	18 × 7	106	102	97·8	93·3	88·7	84·2	79·6	70·5	61·4			
27 J	16 × 6	82·6	78·1	73·6	69·1	64·6	60·1	55·6	46·7				
26 J	15 × 6	80·1	76·0	71·9	67·8	63·7	59·6	55·6	47·4				
25 J	15 × 5	50·1	46·3	42·5	38·8	35·0	31·2						
24 J	14 × 6*a*	77·8	73·9	70·0	66·1	62·2	58·3	54·4	46·6				
23 J	14 × 6*b*	62·2	59·0	55·8	52·6	49·3	46·1	42·9	36·5				
22 J	12 × 6*a*	74·6	71·0	67·5	63·9	60·3	56·7	53·2	46·0				
21 J	12 × 6*b*	60·4	57·4	54·5	51·5	48·6	45·6	42·6	36·7				
20 J	12 × 5	38·9	36·2	33·4	30·6	27·8	25·1						
19 J	10 × 8	107	104	100	97·3	94·0	90·7	87·4	80·8	74·1	67·5	60·9	54·3
18 J	10 × 6	58·5	55·8	53·1	50·3	47·6	44·9	42·2	36·7	31·3			
17 J	10 × 5	37·2	34·7	32·2	29·6	27·1	24·6	22·1					
16 J	9 × 7	86·0	82·9	79·8	76·7	73·6	70·5	67·4	61·1	54·9	48·7		

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909 for stanchions of mild steel having "both ends fixed."

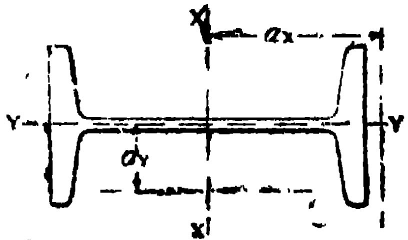
For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

STANCHIONS.

Steel Joists.

Dimensions and Properties



Size, D×B inches.	Weight per foot in lbs.	Area in square inches.	Standard Thicknesses		Radii of Gyration.		Eccentricity Coefficients.			
			Web	Flange	Axis Y–Y	Axis X–X	Web.	Flange	Axis Y–Y	Axis X–X
24 × 7½	100	29·392	·600	1·070	**1·51**	9·50	1·50	2·60	**1 + 1·65a_Y**	1 + 0·13a_X
20 × 7½	89	26·164	·600	1·010	**1·54**	7·99	1·47	2·57	**1 + 1·57a_Y**	1 + 0·16a_X
18 × 7	75	22·066	·550	·928	**1·45**	7·22	1·46	2·56	**1 + 1·66a_Y**	1 + 0·17a_X
16 × 6	62	18·227	·550	·847	**1·22**	6·31	1·56	2·61	**1 + 2·02a_Y**	1 + 0·20a_X
15 × 6	59	17·346	·500	·880	**1·27**	6·02	1·46	2·55	**1 + 1·85a_Y**	1 + 0·21a_X
15 × 5	42	12·351	·420	·647	**0·98**	5·89	1·55	2·62	**1 + 2·59a_Y**	1 + 0·22a_X
14 × 6*a*	57	16·769	·500	·873	**1·29**	5·64	1·45	2·54	**1 + 1·80a_Y**	1 + 0·22a_X
14 × 6*b*	46	13·533	·400	·698	**1·26**	5·70	1·38	2·51	**1 + 1·88a_Y**	1 + 0·22a_X
12 × 6*a*	54	15·879	·500	·883	**1·33**	4·86	1·42	2·52	**1 + 1·69a_Y**	1 + 0·26a_X
12 × 6*b*	44	12·946	·400	·717	**1·31**	4·93	1·35	2·48	**1 + 1·75a_Y**	1 + 0·25a_X
12 × 5	32	9·408	·350	·550	**1·02**	4·83	1·42	2·54	**1 + 2·41a_Y**	1 + 0·26a_X
10 × 8	70	20·582	·600	·970	**1·86**	4·03	1·35	2·49	**1 + 1·15a_Y**	1 + 0·30a_X
10 × 6	42	12·358	·400	·736	**1·36**	4·14	1·33	2·46	**1 + 1·62a_Y**	1 + 0·29a_X
10 × 5	30	8·820	·360	·552	**1·05**	4·06	1·41	2·52	**1 + 2·26a_Y**	1 + 0·30a_X
9 × 7	58	17·064	·550	·924	**1·64**	3·67	1·36	2·51	**1 + 1·29a_Y**	1 + 0·34a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7

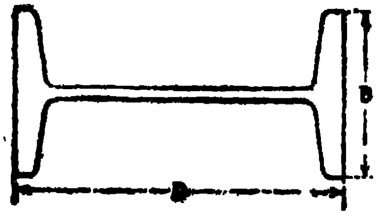
Each weight per foot is for the shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

Ws = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = Ws×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.



STANCHIONS.

Steel Joists.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches	HEIGHTS IN FEET.											
		3	4	5	6	7	8	9	10	11	12	14	16
15 J	9 × 4	33·4	31·1	28·9	26·6	24·4	22·1	19·9	17·6	15·4			
14 J	8 × 6	59·8	57·5	55·2	52·8	50·5	48·1	45·8	43·5	41·1	38·8	34·1	29·4
13 J	8 × 5	46·9	44·7	42·4	40·2	38·0	35·8	33·6	31·3	29·1	26·9	22·5	
12 J	8 × 4	28·6	26·6	24·7	22·8	20·8	18·9	17·0	15·0	13·1			
11 J	7 × 4	25·6	23·9	22·3	20·6	18·9	17·3	15·6	14·0	12·3			
10 J	6 × 5	41·8	39·8	37·8	35·9	33·9	31·9	29·9	27·9	25·9	24·0	20·0	
9 J	6 × 4½	32·7	30·8	29·0	27·1	25·3	23·5	21·6	19·8	17·9	16·1		
8 J	6 × 3	17·7	16·0	14·3	12·6	10·9	9·1						
7 J	5 × 4½	29·7	28·2	26·7	25·1	23·6	22·1	20·5	19·0	17·5	15·9		
6 J	5 × 3	16·7	15·2	13·8	12·3	10·9	9·4	8·0					
4 J	4 × 3	14·4	13·2	11·9	10·7	9·4	8·2	7·0					
2 J	3 × 3	13·0	12·0	10·9	9·9	8·8	7·8	6·7					
1 J	3 × 1½	4·3	3·3										

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, *for* stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

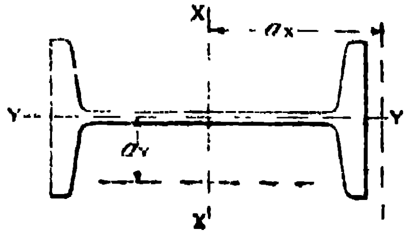
For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

STANCHIONS.

Steel Joists.

Dimensions and Properties.



Size, D × B inches.	Weight per foot in lbs.	Area in square inches.	Standard Thicknesses.		Radii of Gyration.		Eccentricity Coefficients.			
			Web	Flange.	Axis Y - Y	Axis X - X	Web.	Flange.	Axis Y—Y	Axis X—X
9 × 4	21	6·178	·300	·460	**0·82**	3·62	**1·44**	2·54	1 + **2·95a_y**	1 + 0·34a_x
8 × 6	35	10·293	·440	·597	**1·32**	3·28	**1·38**	2·49	1 + **1·72a_y**	1 + 0·37a_x
8 × 5	28	8·241	·350	·575	**1·11**	3·29	**1·35**	2·48	1 + **2·01a_y**	1 + 0·37a_x
8 × 4	18	5·297	·280	·402	**0·82**	3·24	**1·42**	2·52	1 + **2·97a_y**	1 + 0·38a_x
7 × 4	16	4·709	·250	·387	**0·85**	2·88	**1·35**	2·47	1 + **2·76a_y**	1 + 0·42a_x
6 × 5	25	7·354	·410	·520	**1·11**	2·43	**1·42**	2·52	1 + **2·02a_y**	1 + 0·51a_x
6 × 4½	20	5·882	·370	·431	**0·96**	2·42	**1·45**	2·53	1 + **2·45a_y**	1 + 0·51a_x
6 × 3	12	3·527	·260	·348	**0·61**	2·39	**1·52**	2·57	1 + **3·96a_y**	1 + 0·53a_x
5 × 4½	18	5·290	·290	·448	**1·03**	2·07	**1·31**	2·46	1 + **2·11a_y**	1 + 0·58a_x
5 × 3	11	3·238	·220	·376	**0·67**	2·05	**1·37**	2·49	1 + **3·32a_y**	1 + 0·60a_x
4 × 3	9½	2·795	·220	·336	**0·67**	1·64	**1·36**	2·49	1 + **3·28a_y**	1 + 0·74a_x
3 × 3	8½	2·501	·200	·332	**0·71**	1·23	**1·30**	2·49	1 + **2·98a_y**	1 + 0·99a_x
3 × 1½	4	1·176	·160	·248	**0·32**	1·18	**1·57**	2·60	1 + **7·10a_y**	1 + 1·07a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

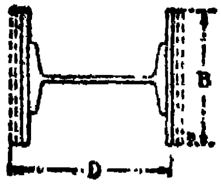
Each weight per foot is for the shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192 L.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.

Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		10	11	12	13	14	16	18	20	24	28	32	36
278 K	27 × 14	398	391	384	378	371	358	345	332	305	279	252	226
276 K	26½ × „	357	351	344	338	332	320	308	295	271	246	222	197
274 K	26 × „	316	310	304	299	293	281	270	259	236	213	190	168
273 K	25¾ × „	295	289	284	278	273	262	251	240	218	196	174	152
272 K	25½ × „	274	269	263	258	253	242	232	221	200	179	157	136
271 K	25¼ × „	253	248	243	238	232	222	212	202	181	161	140	120
258 K	23 × 14	381	375	369	362	356	344	332	319	294	270	245	220
256 K	22½ × „	340	334	329	323	317	306	295	283	260	238	215	192
254 K	22 × „	299	294	289	283	278	268	257	247	226	205	184	163
253 K	21¾ × „	279	274	268	263	258	248	238	228	208	188	168	148
252 K	21½ × „	258	253	248	243	239	229	219	210	190	171	152	132
251 K	21¼ × „	237	232	228	223	218	209	200	191	172	153	135	116
238 K	21 × 12	316	310	304	298	292	280	268	256	231	207	183	159
236 K	20½ × „	282	276	271	265	260	249	237	226	204	181	159	137
234 K	20 × „	248	243	237	232	227	217	207	196	176	155	135	
233 K	19¾ × „	230	225	221	216	211	201	191	181	162	142	122	
232 K	19½ × „	213	208	204	199	194	185	175	166	147	128	110	
231 K	19¼ × „	195	191	186	182	177	168	159	150	133	115	97·0	

Rivets ⅞-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

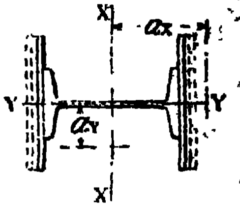
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
24 × 7½	14 × 1½	246½	71·4	**3·24**	11·53	**1·20**	2·37	**1 + 0·67a_Y**	1 + 0·10a_X
"	" × 1¼	223	64·4	**3·15**	11·31	**1·21**	2·37	**1 + 0·71a_Y**	1 + 0·11a_X
"	" × 1	199	57·4	**3·03**	11·07	**1·23**	2·38	**1 + 0·76a_Y**	1 + 0·11a_X
"	" × ⅞	187	53·9	**2·94**	10·94	**1·24**	2·39	**1 + 0·81a_Y**	1 + 0·11a_X
"	" × ¾	175	50·4	**2·85**	10·79	**1·26**	2·40	**1 + 0·86a_Y**	1 + 0·11a_X
"	" × ⅝	163½	46·9	**2·74**	10·64	**1·28**	2·41	**1 + 0·93a_Y**	1 + 0·11a
20 × 7½	14 × 1½	235½	68·1	**3·31**	9·79	**1·19**	2·38	**1 + 0·64a_Y**	1 + 0·12a_X
"	" × 1¼	212	61·1	**3·22**	9·59	**1·20**	2·38	**1 + 0·68a_Y**	1 + 0·12a_X
"	" × 1	188	54·1	**3·10**	9·37	**1·22**	2·38	**1 + 0·73a_Y**	1 + 0·13a_X
"	" × ⅞	179½	50·6	**3·02**	9·25	**1·23**	2·38	**1 + 0·77a_Y**	1 + 0·13a_X
"	" × ¾	164	47·1	**2·93**	9·13	**1·25**	2·39	**1 + 0·82a_Y**	1 + 0·13a_X
"	" × ⅝	152½	43·6	**2·82**	8·99	**1·27**	2·40	**1 + 0·88a_Y**	1 + 0·13a_X
18 × 7	12 × 1½	201	58·0	**2·87**	8·88	**1·20**	2·40	**1 + 0·73a_Y**	1 + 0·14a_X
"	" × 1¼	181	52·0	**2·79**	8·69	**1·21**	2·39	**1 + 0·77a_Y**	1 + 0·14a_X
"	" × 1	160½	46·0	**2·69**	8·48	**1·23**	2·39	**1 + 0·83a_Y**	1 + 0·14a_X
"	" × ⅞	150	43·0	**2·63**	8·37	**1·24**	2·39	**1 + 0·87a_Y**	1 + 0·14a_X
"	" × ¾	140	40·0	**2·56**	8·26	**1·25**	2·40	**1 + 0·92a_Y**	1 + 0·15a_X
"	" × ⅝	130	37·0	**2·47**	8·13	**1·27**	2·40	**1 + 0·98a_Y**	1 + 0·15a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

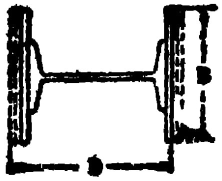
Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark	Size D × B inches	HEIGHTS IN FEET											
		10	11	12	13	14	16	18	20	24	28	32	36
218 K	19 × 12	296	290	285	279	274	263	251	240	218	195	173	151
216 K	18½ × "	262	257	252	247	241	231	221	211	190	170	150	129
214 K	18 × "	228	223	218	214	209	200	190	181	163	144	126	107
213 K	17¾	210	206	202	197	193	184	175	166	149	131	113	
212 K	17½ ×	193	189	185	180	176	168	159	151	134	117	101	
211 K	17¼	176	172	168	164	160	152	144	136	120	104	88·1	
210 K	17 × "	158	154	150	146	143	135	127	120	104	89·7		
198 K	18 × 12	292	286	281	275	270	259	248	237	215	194	172	150
196 K	17½	258	253	248	243	238	228	218	208	188	168	149	129
194 K	17 "	223	219	214	210	205	196	188	179	161	143	125	107
193 K	16¾	206	202	198	193	189	181	172	164	147	130	113	96·0
192 K	16½	189	185	181	177	173	165	157	149	132	116	100	
191 K	16¼ "	172	168	164	160	156	149	141	133	118	103	87·8	
190 K	16	154	150	147	143	139	132	125	118	105	89·0	74·4	
178 K	17 × 12	289	284	278	273	267	257	246	235	214	192	171	149
176 K	16½	255	250	245	240	235	226	216	206	187	167	148	128
174 K	16	221	216	212	207	203	194	185	177	159	142	124	106
173 K	15¾	203	199	195	191	187	178	170	162	145	128	112	95·6
172 K	15½	186	182	178	174	170	162	155	147	131	115	100	
171 K	15¼	169	165	161	158	154	146	139	132	117	102	87·2	
170 K	15 × "	151	148	144	141	137	130	123	116	102	88·1	73·9	

Rivets ¾ in diam at 6 in pitch

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

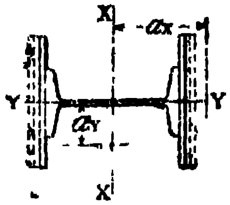
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed"

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c , see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs	Area in square inches.	Radii of Gyration		Eccentricity Coefficients.			
One steel Joist.	Plates, each flange to form			Axis Y-Y	Axis X-X	Web.	Flange.	Axis Y-Y	Axis X-X
16 × 6	12 × 1½	187	54·2	**2·91**	8·02	**1·20**	2·41	**1 + 0·71a_y**	1 + 0·15a_x
"	" × 1¼	166½	48·2	**2·83**	7·83	**1·21**	2·40	**1 + 0·75a_y**	1 + 0·15a_x
"	" × 1	146	42·2	**2·73**	7·63	**1·22**	2·39	**1 + 0·81a_y**	1 + 0·16a_x
"	" × ⅞	136	39·2	**2·66**	7·52	**1·23**	2·39	**1 + 0·85a_y**	1 + 0·16a_x
"	" × ¾	125¼	36·2	**2·59**	7·41	**1·25**	2·40	**1 + 0·90a_y**	1 + 0·16a_x
"	" × ⅝	115½	33·2	**2·49**	7·28	**1·27**	2·40	**1 + 0·97a_y**	1 + 0·16a_x
"	" × ½	105½	30·2	**2·38**	7·14	**1·29**	2·42	**1 + 1·06a_y**	1 + 0·17a_x
15 × 6	12 × 1½	184	53·3	**2·93**	7·60	**1·18**	2·40	**1 + 0·70a_y**	1 + 0·16a_x
"	" × 1¼	163½	47·3	**2·86**	7·45	**1·18**	2·39	**1 + 0·73a_y**	1 + 0·16a_x
"	" × 1	143	41·3	**2·76**	7·24	**1·20**	2·38	**1 + 0·79a_y**	1 + 0·16a_x
"	" × ⅞	133	38·3	**2·70**	7·13	**1·21**	2·38	**1 + 0·82a_y**	1 + 0·17a_x
"	" × ¾	122¼	35·3	**2·65**	7·05	**1·22**	2·38	**1 + 0·87a_y**	1 + 0·17a_x
"	" × ⅝	112½	32·3	**2·53**	6·91	**1·24**	2·38	**1 + 0·93a_y**	1 + 0·17a_x
"	" × ½	102½	29·3	**2·42**	6·78	**1·26**	2·39	**1 + 1·02a_y**	1 + 0·18a_x
14 × 6	12 × 1½	182	52·7	**2·95**	7·10	**1·17**	2·41	**1 + 0·69a_y**	1 + 0·17a_x
"	" × 1¼	161½	46·7	**2·88**	6·95	**1·18**	2·40	**1 + 0·73a_y**	1 + 0·17a_x
"	" × 1	141	40·7	**2·78**	6·80	**1·20**	2·39	**1 + 0·78a_y**	1 + 0·18a_x
"	" × ⅞	131	37·7	**2·72**	6·70	**1·20**	2·38	**1 + 0·81a_y**	1 + 0·18a_x
"	" × ¾	120½	34·7	**2·65**	6·59	**1·22**	2·38	**1 + 0·86a_y**	1 + 0·18a_x
"	" × ⅝	110½	31·7	**2·56**	6·48	**1·23**	2·38	**1 + 0·92a_y**	1 + 0·18a_x
"	" × ½	100½	28·7	**2·44**	6·36	**1·25**	2·39	**1 + 1·01a_y**	1 + 0·19a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

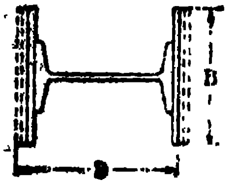
Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We=actual eccentric load; K=relative eccentricity coefficient; Wc=equivalent concentric value; Wc=We×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192 L.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.

Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		10	11	12	13	14	16	18	20	24	28	32	36
158 K	17 × 12	272	267	263	258	253	243	233	223	204	184	164	145
156 K	16½ × "	238	234	230	225	221	212	203	194	177	159	141	124
154 K	16 × "	204	200	196	193	189	181	173	165	149	134	118	102
153 K	15¾ × "	187	183	180	176	172	165	158	150	136	121	106	91·9
152 K	15½ × "	170	167	163	160	156	149	142	136	122	108	94·7	80·9
151 K	15¼ × "	153	150	146	143	140	133	127	121	108	95·3	82·4	
150 K	15 × "	135	132	129	126	123	117	111	105	93·8	81·7	69·7	
138 K	15 × 12	284	279	274	269	264	253	243	232	211	190	169	149
136 K	14½ × "	250	246	241	236	231	222	213	203	184	165	146	127
134 K	14 × "	216	212	208	204	199	191	182	174	157	140	123	106
133 K	13¾ × "	199	195	191	187	183	175	167	159	143	127	111	95·1
132 K	13½ × "	182	178	174	171	167	159	152	144	129	114	99·0	
131 K	13¼ × "	165	161	157	154	150	143	136	129	115	100	86·5	
130 K	13 × "	147	144	140	137	134	127	120	113	100	87·0	73·5	
118 K	15 × 12	269	265	260	255	250	241	231	221	202	183	163	144
116 K	14½ × "	235	231	227	223	218	210	201	192	175	158	140	123
114 K	14 × "	201	198	194	190	186	178	171	163	148	133	117	102
113 K	13¾ × "	184	181	177	174	170	163	156	149	134	120	106	91·7
112 K	13½ × "	167	164	161	157	154	147	140	134	120	107	94·1	80·7
111 K	13¼ × "	150	147	144	141	138	131	125	119	106	94·3	81·9	
110 K	13 × "	133	130	127	124	121	115	110	104	92·6	81·0	69·4	

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

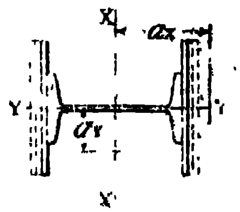
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y–Y	Axis X–X	Web.	Flange	Axis Y–Y	Axis X–X
11 × 6b	12 × 1½	171	49·5	**3·02**	7·26	1·13	2·37	**1 + 0·66a_Y**	1 + 0·16a_X
"	" × 1¼	150½	43·5	**2·96**	7·09	1·14	2·36	**1 + 0·69a_Y**	1 + 0·17a_X
"	" × 1	130	37·5	**2·87**	6·91	1·15	2·34	**1 + 0·73a_Y**	1 + 0·17a_X
"	" × ⅞	120	34·5	**2·81**	6·81	1·15	2·34	**1 + 0·76a_Y**	1 + 0·17a_X
"	" × ¾	109½	31·5	**2·74**	6·71	1·16	2·34	**1 + 0·80a_Y**	1 + 0·17a_X
"	" × ⅝	99½	28·5	**2·66**	6·60	1·17	2·34	**1 + 0·85a_Y**	1 + 0·18a_X
"	" × ½	89½	25·5	**2·54**	6·48	1·19	2·34	**1 + 0·93a_Y**	1 + 0·18a_X
12 × 6a	12 × 1½	179	51·8	**2·98**	6·24	1·17	2·45	**1 + 0·68a_Y**	1 + 0·19a_X
"	" × 1¼	158½	45·8	**2·91**	6·08	1·18	2·42	**1 + 0·71a_Y**	1 + 0·20a_X
"	" × 1	138	39·8	**2·81**	5·91	1·19	2·41	**1 + 0·76a_Y**	1 + 0·20a_X
"	" × ⅞	128	36·8	**2·75**	5·81	1·20	2·40	**1 + 0·79a_Y**	1 + 0·21a_X
"	" × ¾	117½	33·8	**2·68**	5·72	1·21	2·40	**1 + 0·83a_Y**	1 + 0·21a_X
"	" × ⅝	107½	30·8	**2·59**	5·61	1·22	2·39	**1 + 0·89a_Y**	1 + 0·21a_X
"	" × ½	97½	27·8	**2·48**	5·50	1·24	2·40	**1 + 0·97a_Y**	1 + 0·22a_X
12 × 6b	12 × 1½	169	48·9	**3·04**	6·33	1·13	2·41	**1 + 0·65a_Y**	1 + 0·19a_X
"	" × 1¼	148½	42·9	**2·98**	6·17	1·14	2·38	**1 + 0·68a_Y**	1 + 0·19a_X
"	" × 1	128	36·9	**2·90**	6·00	1·14	2·36	**1 + 0·72a_Y**	1 + 0·20a_X
"	" × ⅞	118	33·9	**2·84**	5·91	1·15	2·35	**1 + 0·74a_Y**	1 + 0·20a_X
"	" × ¾	107½	30·9	**2·77**	5·82	1·16	2·35	**1 + 0·78a_Y**	1 + 0·20a_X
"	" × ⅝	97½	27·9	**2·69**	5·72	1·17	2·34	**1 + 0·83a_Y**	1 + 0·20a_X
"	" × ½	87½	24·9	**2·58**	5·61	1·18	2·35	**1 + 0·90a_Y**	1 + 0·21a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

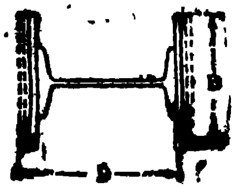
Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		10	11	12	13	14	16	18	20	24	28	32	36
102 K	13½ × 10	127	124	121	118	115	108	102	96·3	83·8	71·3		
101 K	13¼ × „	113	110	107	104	102	96·2	90·5	84·7	73·2	61·6		
100 K	13 × „	99·5	96·9	94·2	91·6	88·9	83·6	78·3	72·9	62·3	51·7		
99 K	12¾ × „	85·3	82·9	80·4	77·9	75·5	70·6	65·7	60·8	50·9			
92 K	14 × 14	433	427	421	414	408	395	382	369	344	318	293	267
90 K	13½ × „	393	387	381	375	369	357	346	334	310	287	263	240
88 K	13 × „	352	347	342	336	331	320	309	298	277	255	234	212
86 K	12½ × 12	276	271	266	261	256	245	235	224	204	183	162	141
84 K	12 × „	242	237	233	228	223	214	205	195	176	157	139	120
83 K	11¾ × „	225	221	216	212	207	198	189	180	162	145	127	109
82 K	11½ × „	208	204	199	195	191	182	174	165	149	132	115	98·1
81 K	11¼ × „	191	187	183	179	175	167	159	151	134	118	102	
80 K	11 × „	173	170	166	162	158	151	143	135	120	105	90·2	
68 K	13 × 12	267	262	257	252	248	238	229	219	200	181	162	144
66 K	12½ × „	233	228	224	220	216	207	199	190	173	157	140	123
64 K	12 × „	199	195	191	187	184	176	169	161	146	131	116	102
63 K	11¾ × „	181	178	174	171	168	161	154	147	133	119	105	91·3
62 K	11½ × „	164	161	158	155	151	145	138	132	119	106	93·4	80·4
61 K	11¼ × „	147	144	141	138	135	129	123	117	105	93·4	81·3	69·3
60 K	11 × 10	114	111	108	105	102	96·0	89·9	83·7	71·4	59·1		
59 K	10¾ × „	100	97·4	94·6	91·7	88·8	83·1	77·3	71·6	60·1			

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

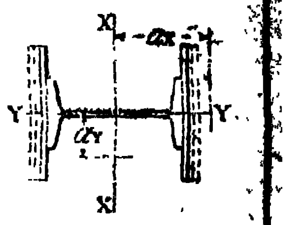
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y-Y	Axis X—X	Web.	Flange.	Axis Y Y	Axis X—X
12 × 5	10 × $\frac{3}{4}$	85½	24·4	**2·35**	5·83	**1·16**	2·34	**1 + 0·91a_Y**	1 + 0·20a_x
"	" × $\frac{5}{8}$	77	21·9	**2·28**	5·72	**1·17**	2·34	**1 + 0·96a_Y**	1 + 0·20a_x
"	" × $\frac{1}{2}$	68½	19·4	**2·19**	5·60	**1·18**	2·35	**1 + 1·04a_Y**	1 + 0·21a_x
"	" × $\frac{3}{8}$	60	16·9	**2·06**	5·47	**1·21**	2·36	**1 + 1·17a_Y**	1 + 0·21a_x
10 × 8	14 × 2	264	76·6	**3·59**	5·57	**1·17**	2·58	**1 + 0·55a_Y**	1 + 0·23a_x
"	" × 1$\frac{3}{4}$	240½	69·6	**3·54**	5·42	**1·17**	2·55	**1 + 0·56a_Y**	1 + 0·23a_x
"	" × 1$\frac{1}{2}$	216½	62·6	**3·48**	5·27	**1·18**	2·52	**1 + 0·58a_Y**	1 + 0·24a_x
"	12 × 1$\frac{1}{4}$	176	50·6	**2·92**	5·06	**1·21**	2·52	**1 + 0·71a_Y**	1 + 0·25a_x
"	" × 1	155½	44·6	**2·84**	4·90	**1·23**	2·50	**1 + 0·75a_Y**	1 + 0·25a_x
"	" × $\frac{7}{8}$	145	41·6	**2·79**	4·82	**1·23**	2·49	**1 + 0·77a_Y**	1 + 0·25a_x
"	" × $\frac{3}{4}$	135	38·6	**2·73**	4·73	**1·24**	2·48	**1 + 0·81a_Y**	1 + 0·26a_x
"	" × $\frac{5}{8}$	125	35·6	**2·66**	4·65	**1·26**	2·47	**1 + 0·85a_Y**	1 + 0·26a_x
"	" × $\frac{1}{2}$	114½	32·6	**2·57**	4·55	**1·27**	2·46	**1 + 0·91a_Y**	1 + 0·27a_x
10 × 6	12 × 1$\frac{1}{2}$	167	48·3	**3·06**	5·39	**1·13**	2·45	**1 + 0·64a_Y**	1 + 0·23a_x
"	" × 1$\frac{1}{4}$	146½	42·3	**3·00**	5·24	**1·13**	2·42	**1 + 0·67a_Y**	1 + 0·23a_x
"	" × 1	126	36·3	**2·92**	5·08	**1·14**	2·40	**1 + 0·70a_Y**	1 + 0·23a_x
"	" × $\frac{7}{8}$	116	33·3	**2·87**	5·00	**1·15**	2·38	**1 + 0·73a_Y**	1 + 0·24a_x
"	" × $\frac{3}{4}$	105½	30·3	**2·80**	4·91	**1·15**	2·37	**1 + 0·76a_Y**	1 + 0·24a_x
"	" × $\frac{5}{8}$	95½	27·3	**2·72**	4·82	**1·16**	2·36	**1 + 0·81a_Y**	1 + 0·24a_x
"	10 × $\frac{1}{2}$	78½	22·3	**2·18**	4·67	**1·21**	2·39	**1 + 1·06a_Y**	1 + 0·25a_x
"	" × $\frac{3}{8}$	70	19·8	**2·07**	4·56	**1·23**	2·39	**1 + 1·16a_Y**	1 + 0·26a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

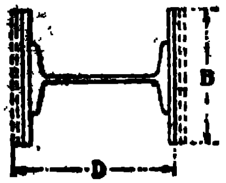
Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_x respectively.

For full explanations of tables, see notes commencing page 192 L.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		10	11	12	13	14	16	18	20	24	28	32	36
54 K	12 × 10	152	148	145	141	138	131	124	117	103	89·5	75·5	
53 K	11¾ × "	138	135	132	128	125	119	112	106	93·2	80·2	67·2	
52 K	11½ × "	124	121	118	115	112	106	100	94·7	82·7	70·7		
51 K	11¼ × 9	101	98·3	95·4	92·5	89·6	83·8	77·9	72·1	60·5			
50 K	11 × "	88·9	86·2	83·5	80·8	78·2	72·8	67 4	62 0	51·3			
49 K	10¾ × "	76·4	73·9	71·4	68·9	66·5	60·5	55·6	50·6	41·7			
38 K	12 × 12	291	286	281	275	270	260	249	238	217	196	175	154
36 K	11½ × "	257	253	248	243	238	229	219	209	190	171	152	132
34 K	11 × "	223	219	215	210	206	197	189	180	163	146	128	111
33 K	10¾ × 10	180	176	171	167	163	154	145	136	119	101		
32 K	10½ × "	166	162	158	154	150	141	133	125	108	91·8		
31 K	10¼ × "	152	148	144	141	137	129	121	113	97·8	82·1		
30 K	10 × "	138	135	131	127	123	116	109	101	86·8	72·0		
24 K	10 × 10	160	156	152	149	145	138	130	123	108	93·8	79·1	
23 K	9¾ × "	146	142	139	135	132	125	118	111	98·2	84·4	70·7	
22 K	9½ × "	132	129	126	122	119	113	106	100	87·8	75·0		
21 K	9¼ × 9	109	105	102	99·7	96·7	90·5	84·3	78·1	65·7			
20 K	9 × "	96·7	93·8	91·0	88·1	85·2	79·5	73·8	68·0	56·6			
19 K	8¾ × "	84·2	81·6	78·9	76·3	73·6	68·3	63·0	57·7	47·2			
14 K	10 × 10	149	146	142	139	136	129	122	115	102	82·7	75·2	
13 K	9¾ × "	135	132	129	126	123	117	110	104	92·0	79·5	66·9	
12 K	9½ × "	122	119	116	113	110	104	99·0	93·2	81·7	70·1	*58·5*	
11 K	9¼ × 9	98·8	96·0	93·3	90·5	87·7	82·1	76·6	71·0	59·9	48·8		
10 K	9 × "	86·5	84·0	81·4	78·9	76·3	71·2	66·1	61·0	50·8			
9 K	8¾ × "	74·1	71·8	69·4	67·1	64·8	60·1	55·5	50·8	41·5			

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

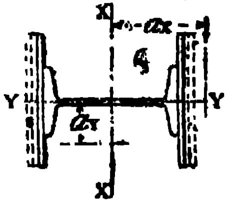
For other conditions and formulæ, see notes commencing page 192 L.

The safe load printed in italics is for a height greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Radii of Gyration.		Eccentricity Coefficients.			
One Steel Joist.	Plates, each flange to form.			Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
10 × 5	10 × 1	100½	28·8	**2·47**	5·11	**1·15**	2·38	$1+0{\cdot}82a_Y$	$1+0{\cdot}23a_X$
"	" × ⅞	92	26·3	**2·43**	5·02	**1·15**	2·37	$1+0{\cdot}85a_Y$	$1+0{\cdot}23a_X$
"	" × ¾	83½	23·8	**2·38**	4·93	**1·16**	2·36	$1+0{\cdot}89a_Y$	$1+0{\cdot}24a_X$
"	9 × ⅝	70½	20·0	**2·06**	4·80	**1·19**	2·37	$1+1{\cdot}06a_Y$	$1+0{\cdot}24a_X$
"	" × ½	63	17·8	**1·99**	4·70	**1·21**	2·37	$1+1{\cdot}14a_Y$	$1+0{\cdot}25a_X$
"	" × ⅜	55½	15·5	**1·88**	4·58	**1·23**	2·38	$1+1{\cdot}27a_Y$	$1+0{\cdot}26a_X$
9 × 7	12 × 1½	184	53·0	**3·00**	4·81	**1·19**	2·56	$1+0{\cdot}67a_Y$	$1+0{\cdot}26a_X$
"	" × 1¼	164	47·0	**2·94**	4·66	**1·19**	2·53	$1+0{\cdot}70a_Y$	$1+0{\cdot}27a_X$
"	" × 1	143½	41·0	**2·85**	4·50	**1·20**	2·50	$1+0{\cdot}74a_Y$	$1+0{\cdot}27a_X$
"	10 × ⅞	121½	34·5	**2·35**	4·36	**1·25**	2·52	$1+0{\cdot}90a_Y$	$1+0{\cdot}28a_X$
"	" × ¾	113	32·0	**2·31**	4·28	**1·26**	2·51	$1+0{\cdot}94a_Y$	$1+0{\cdot}29a_X$
"	" × ⅝	104½	29·5	**2·25**	4·19	**1·27**	2·50	$1+0{\cdot}98a_Y$	$1+0{\cdot}29a_X$
"	" × ½	96	27·0	**2·19**	4·10	**1·29**	2·49	$1+1{\cdot}05a_Y$	$1+0{\cdot}30a_X$
8 × 6	10 × 1	105½	30·3	**2·47**	4·13	**1·18**	2·47	$1+0{\cdot}82a_Y$	$1+0{\cdot}29a_X$
"	" × ⅞	97	27·8	**2·42**	4·05	**1·19**	2·45	$1+0{\cdot}85a_Y$	$1+0{\cdot}30a_X$
"	" × ¾	88½	25·3	**2·37**	3·97	**1·20**	2·43	$1+0{\cdot}89a_Y$	$1+0{\cdot}30a_X$
"	9 × ⅝	75½	21·5	**2·09**	3·85	**1·23**	2·44	$1+1{\cdot}03a_Y$	$1+0{\cdot}31a_X$
"	" × ½	68	19·3	**2·02**	3·76	**1·24**	2·43	$1+1{\cdot}11a_Y$	$1+0{\cdot}32a_X$
"	" × ⅜	60½	17·0	**1·93**	3·66	**1·27**	2·43	$1+1{\cdot}21a_Y$	$1+0{\cdot}33a_X$
8 × 5	10 × 1	98½	28·2	**2·50**	4·19	**1·14**	2·43	$1+0{\cdot}80a_Y$	$1+0{\cdot}29a_X$
"	" × ⅞	90	25·7	**2·46**	4·11	**1·15**	2·41	$1+0{\cdot}83a_Y$	$1+0{\cdot}29a_X$
"	" × ¾	81½	23·2	**2·41**	4·03	**1·15**	2·39	$1+0{\cdot}86a_Y$	$1+0{\cdot}29a_X$
"	9 × ⅝	69	19·5	**2·10**	3·91	**1·18**	2·40	$1+1{\cdot}02a_Y$	$1+0{\cdot}30a_X$
"	" × ½	61	17·2	**2·03**	3·82	**1·19**	2·39	$1+1{\cdot}10a_Y$	$1+0{\cdot}31a_X$
"	" × ⅜	53½	15·0	**1·93**	3·72	**1·21**	2·38	$1+1{\cdot}21a_Y$	$1+0{\cdot}32a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

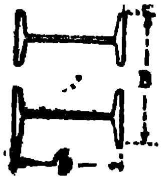
Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

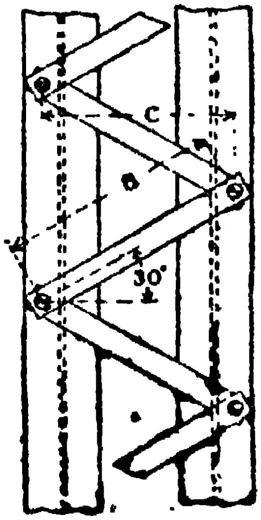
For full explanations of tables, see notes commencing page 192 L.



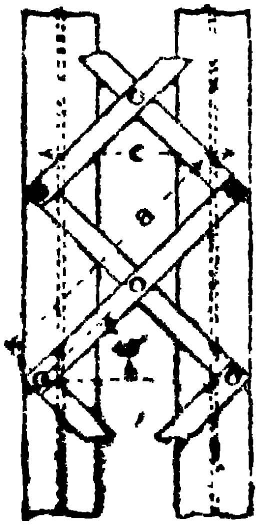
COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

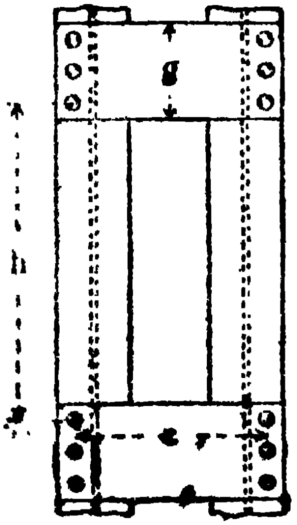
Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		10	12	14	16	18	20	22	24	28	32	36	40
30 L	24 × 26	363	359	355	352	348	344	340	336	329	321	314	306
29 L	20 × 23	320	316	312	308	304	300	296	292	284	276	268	260
28 L	18 × 21	268	264	260	257	253	249	246	242	235	227	220	212
27 L	16 × 18	219	215	211	208	204	201	197	194	186	179	172	165
26 L	15 × 17	207	203	199	196	192	188	184	181	173	166	159	151
25 L	15 × 16	147	144	142	139	136	134	131	128	123	118	112	107
24 L	14 × 17	200	196	193	189	185	182	178	175	168	160	153	146
23 L	14 × 17	161	158	155	152	150	147	144	141	135	129	124	118



SINGLE LATTICING.
Suitable for values of *c*, not exceeding 15 inches.



DOUBLE LATTICING.



BATTEN PLATES.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

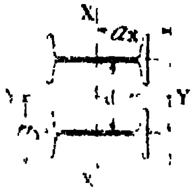
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of two Steel Joists Latticed.	Weight per foot in lbs.	Area in square inches.	d. Centres of Webs. Inches.	Radii of Gyration.		Eccentricity Coefficients.			
				Axis Y–Y	Axis X–X	Web.	Flange.	Axis Y–Y	Axis X–X
24 × 7½	200	58·8	18·5	**9·37**	9·50	**2·42**	2·60	1 + **0·15a_Y**	1 + 0·13a_X
20 × 7½	178	52·3	15·5	**7·90**	7·99	**2·48**	2·57	1 + **0·19a_Y**	1 + 0·16a_X
18 × 7	150	44·1	14·0	**7·15**	7·22	**2·50**	2·56	1 + **0·21a_Y**	1 + 0·17a_X
16 × 6	124	36·4	12·0	**6·12**	6·31	**2·51**	2·61	1 + **0·24a_Y**	1 + 0·20a_X
15 × 6	118	34·7	11·0	**5·64**	6·02	**2·53**	2·55	1 + **0·27a_Y**	1 + 0·21a_X
15 × 5	84	24·7	11·0	**5·59**	5·89	**2·47**	2·62	1 + **0·26a_Y**	1 + 0·22a_X
14 × 6*a*	114	33·5	11·0	5·65	**5·64**	2·53	**2·54**	1 + 0·27a_Y	1 + **0·22a_X**
14 × 6*b*	92	27·0	11·0	**5·64**	5·70	**2·52**	2·51	1 + **0·27a_Y**	1 + 0·22a_X

CONVENTIONAL MAXIMUM SPACING AND MINIMUM PROPORTIONS OF LATTICE BARS AND BATTEN PLATES FOR CONCENTRIC LOADING (*Am. Ry. Engineering and Maintenance of Way Assoc.*).

Width of Joist Flange. Inches.	7½	7	6	5
Width of Lattice Bar. Inches.	2½	2½	2¼	2¼
Diameter of Rivet.	⅞	⅞	¾	¾

SINGLE LATTICING –

Maximum angle of inclination with horizontal = 30 degrees

Minimum thickness = 1/40th of *a*, the diagonal centres of rivets.

Maximum horizontal centres of rivets, *e* = 10 inches

DOUBLE LATTICING –

Maximum angle of inclination with horizontal = 45 degrees.

Minimum thickness = 1/60th of *a*, the diagonal centres of rivets.

BATTEN PLATES –

Maximum centres of end rivets of batten plates = *h* inches.

Let *l* = height of stanchion in inches, and *k* = radius of gyration of one joist.

Then $h = \frac{l \times k \text{ least.}}{k \text{ greatest.}}$

Minimum thickness = 1/50th of *e*, the horizontal centres of rivets.

Minimum width *g* = *e*, the horizontal centres of rivets for end plates.

" " *g* = ½*e*, " " " intermediate plates.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

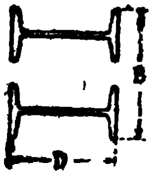
Each weight per foot is for the shaft only. Weights of lattices, bases, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient, Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

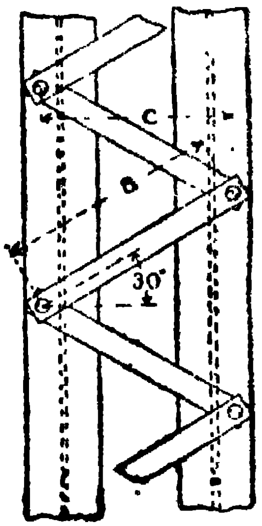
For full explanations of tables, see notes commencing page 192 L.



COMPOUND STANCHIONS.

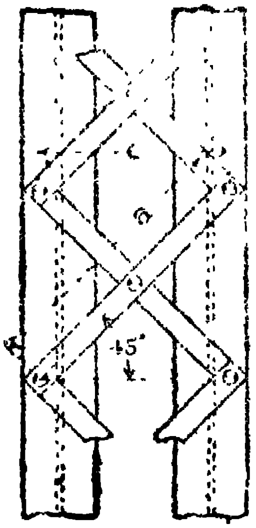
Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		10	12	14	16	18	20	22	24	28	32	36	40
22 L	12 × 15	186	182	178	174	170	165	161	157	149	141	133	125
21 L	12 × 15	151	148	145	141	138	135	131	128	121	115	108	102
20 L	12 × 14	110	107	105	102	100	97·8	95·3	92·9	88·0	83·1	78·2	73·3
18 L	10 × 13	140	137	133	129	125	121	117	113	105	97·4	*89·5*	*81·6*
17 L	10 × 12	100	97·2	94·3	91·5	88·6	85·7	82·8	79·9	74·1	68·3	*62·5*	*56·7*
15 L	9 × 11	70·0	67·9	65·8	63·8	61·7	59·6	57·6	55·5	51·4	*47·3*	*43·2*	*39·0*
14 L	8 × 12	114	111	107	103	99·8	96·1	92·3	88·5	*81·0*	*73·5*	*65·9*	*58·4*
13 L	8 × 11	91·6	88·6	85·5	82·4	79·3	76·2	73·1	70·0	*63·8*	*57·6*	*51·5*	*45·3*

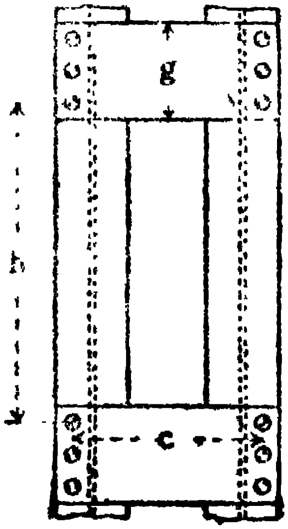


SINGLE LATTICING.

Suitable for values of *c*, not exceeding 15 inches.



DOUBLE LATTICING



BATTEN PLATES.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

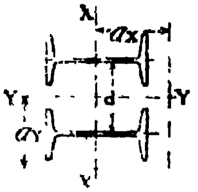
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of two Steel Joists Latticed.	Weight per foot in lbs.	Area in square inches.	d. Centre of Web Inches	Radii of Gyration. Axis Y–Y	Radii of Gyration. Axis X–X	Eccentricity Coefficients. Web.	Eccentricity Coefficients. Flange	Eccentricity Coefficients. Axis Y—Y	Eccentricity Coefficients. Axis X—X
12 × 6*a*	108	31·7	9·0	**4·69**	4·86	2·62	3·52	**$1+0·34a_Y$**	$1+0·26a_X$
12 × 6*b*	88	25·9	9·0	**4·68**	4·93	2·61	2·48	**$1+0·34a_Y$**	$1+0·25a_X$
12 × 5	64	18·8	9·0	**4·61**	4·83	2·54	2·54	**$1+0·33a_Y$**	$1+0·26a_X$
10 × 6	84	24·7	7·0	**3·75**	4·14	2·71	2·46	**$1+0·46a_Y$**	$1+0·29a_X$
10 × 5	60	17·6	7·5	**3·65**	4·06	2·65	2·52	**$1+0·45a_Y$**	$1+0·30a_X$
9 × 4	42	12·3	7·0	**3·59**	3·62	2·55	2·51	**$1+0·43a_Y$**	$1+0·34a_X$
8 × 6	70	20·5	6·0	**3·27**	3·28	2·80	2·49	**$1+0·56a_Y$**	$1+0·37a_X$
8 × 5	56	16·5	6·0	**3·20**	3·29	2·71	2·48	**$1+0·54a_Y$**	$1+0·37a_X$

CONVENTIONAL MAXIMUM SPACING AND MINIMUM PROPORTIONS OF LATTICE BARS AND BATTEN PLATES FOR CONCENTRIC LOADING (*Am. Ry. Engineering and Maintenance of Way Assoc.*).

Width of Joist Flange Inches	6	5	4
Width of Lattice Bar Inches	[illegible]	2¼	2
Diameter of Rivets	[illegible]	[illegible]	⅝

SINGLE LATTICING.

Maximum angle of inclination with horizontal [illegible] degrees.
Minimum thickness = 1/40th of *a*, the diagonal centre of rivets.
Maximum horizontal centres of rivets, *c* = [illegible] inches.

DOUBLE LATTICING—

Maximum angle of inclination with horizontal = 45 degrees.
Maximum thickness = 1/60th of *a* the diagonal centres of rivets.

BATTEN PLATES—

Maximum centres of end rivets of batten plates = *h* inches.
Let *l* = height of stanchion in inches, and *k* = radius of gyration of one joist.

Then $h = \dfrac{l \times k \text{ least.}}{k \text{ greatest.}}$

Minimum thickness = 1/50th of *c*, the horizontal centres of rivets.
Minimum width *g* = *c*, the horizontal centres of rivets for end plates.
" " $g = \frac{1}{2}c$, " " " intermediate plates.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

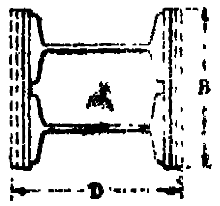
Each weight per foot is for the shaft only. Weights of lattices, bases, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W = actual eccentric load; K = relative eccentricity coefficient; We = equivalent concentric value; We = W × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	[illegible]	HEIGHTS IN FEET 10	12	14	16	18	20	22	24	28	32	36	40
282 M	28 × 24	[illegible]	[illegible]	908	[illegible]	880	866	852	838	810	782	754	727
280 M	27½ × "	863	850	837	824	811	798	786	773	747	721	695	669
278 M	27 × "	790	778	766	755	743	731	719	707	683	660	636	612
276 M	26½ × "	717	707	696	685	674	663	652	641	620	598	576	555
274 M	26 × "	645	635	625	615	605	596	586	576	556	537	517	497
273 M	25¾ × 20	557	547	537	526	516	506	495	485	464	444	423	402
272 M	25½ × "	527	518	508	498	488	478	468	459	439	419	400	380
271 M	25¼ × 18	478	468	458	448	438	428	418	408	388	368	348	328
262 M	[illegible] × 24	[illegible]	[illegible]	871	857	[illegible]	831	817	804	777	751	724	697
260 M	23½ × "	824	811	800	787	775	763	750	738	714	689	664	640
258 M	23 × "	751	740	729	718	706	695	684	673	650	628	605	583
256 M	22½ × 20	598	588	[illegible]	[illegible]	564	555	542	531	505	486	464	442
254 M	22 × "	549	539	529	519	509	498	488	478	458	438	418	397
253 M	21¾ × "	519	510	500	490	481	471	462	452	433	414	394	375
252 M	21½ × "	489	480	471	461	452	443	434	426	408	389	371	353
251 M	21¼ × 18	440	431	422	412	403	394	385	376	357	339	321	302
242 M	22 × 18	685	671	657	643	629	616	602	588	560	532	505	477
240 M	21½ × "	632	619	606	593	580	568	555	542	516	491	465	439
238 M	21 × "	578	567	555	543	531	519	508	496	472	449	425	401
236 M	20½ × "	525	514	504	493	482	471	460	450	428	407	385	364
234 M	20 × "	472	462	452	442	433	423	413	404	384	365	345	326
233 M	19¾ × 16	419	409	399	390	380	370	360	350	331	311	291	272
232 M	19½ × "	396	386	377	368	359	349	340	331	312	293	275	256
231 M	19¼ × "	372	364	355	346	337	328	320	311	293	276	258	240

Rivets ⅞-in. diam. at 6-in. pitch.

The above safe loads are taken for ratios of slenderness up to, but not exceeding 160.

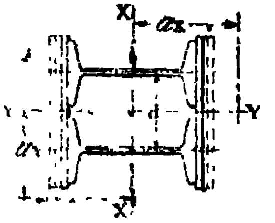
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs.	Area in square inches.	Centre of Webs in inches.	Radii of Gyration				Eccentricity Coefficients.	
Two Steel Joists.	Plates, each flange to form.				Axis Y–Y	Axis X–X	Web.	Flange.	Axis Y–Y	Axis X–X
24 × 7½	24 × 2	530	154·8	12	**6·65**	11·80	**2·71**	2·41	**$1 + 0·27a_Y$**	$1 + 0·10a_X$
"	" × 1¾	489½	142·8	"	**6·63**	11·61	**2·72**	2·40	**$1 + 0·27a_Y$**	$1 + 0·10a_X$
"	" × 1½	448½	130·8	"	**6·60**	11·41	**2·74**	2·40	**$1 + 0·28a_Y$**	$1 + 0·11a_X$
"	" × 1¼	407½	118·8	"	**6·57**	11·22	**2·75**	2·40	**$1 + 0·28a_Y$**	$1 + 0·11a_X$
"	" × 1	364	106·8	"	**6·53**	10·95	**2·78**	2·41	**$1 + 0·28a_Y$**	$1 + 0·11a_X$
"	20 × ⅞	322½	93·8	10	**5·43**	10·69	**2·80**	2·45	**$1 + 0·34a_Y$**	$1 + 0·11a_X$
"	" × ¾	305½	88·8	"	**5·41**	10·56	**2·81**	2·46	**$1 + 0·34a_Y$**	$1 + 0·12a_X$
"	18 × ⅝	280	81·3	9	**4·87**	10·36	**2·82**	2·48	**$1 + 0·38a_Y$**	$1 + 0·12a_X$
20 × 7½	24 × 2	508	148·3	12	**6·68**	10·05	**2·70**	2·43	**$1 + 0·27a_Y$**	$1 + 0·12a_X$
"	" × 1¾	467½	136·3		**6·65**	9·87	**2·71**	2·42	**$1 + 0·27a_Y$**	$1 + 0·12a_X$
"	" × 1½	426½	124·3		**6·63**	9·69	**2·72**	[illegible]	**$1 + 0·27a_Y$**	$1 + 0·12a_X$
"	20 × 1¼	351½	102·5	10	**5·50**	9·35	**2·75**	2·44	**$1 + 0·33a_Y$**	$1 + 0·13a_X$
"	" × 1	318	92·8		**5·47**	[illegible]	**2·77**	2·44	**$1 + 0·34a_Y$**	$1 + 0·13a_X$
"	" × ⅞	300½	87·3		**5·45**	[illegible]	**2·78**	[illegible]	**$1 + 0·34a_Y$**	$1 + 0·13a_X$
"	" × ¾	283½	82·3		**5·4[illegible]**	8·93	**2·80**	[illegible]	**$1 + 0·34a_Y$**	$1 + 0·14a_X$
"	18 × ⅝	255	74·8	9	**4·89**	8·75	**2·81**	2·47	**$1 + 0·38a_Y$**	$1 + 0·14a_X$
18 × 7	18 × 2	398½	116·1	9	**5·02**	[illegible]	**2·71**	2·48	**$1 + 0·36a_Y$**	$1 + 0·14a_X$
"	" × 1¾	368	107·1	"	**5·01**	8·88	**2·72**	2·47	**$1 + 0·36a_Y$**	$1 + 0·14a_X$
"	" × 1½	337½	98·1	"	**4·99**	8·71	**2·73**	2·46	**$1 + 0·36a_Y$**	$1 + 0·14a_X$
"	" × 1¼	307	89·1	"	**4·97**	8·52	**2·74**	2·45	**$1 + 0·37a_Y$**	$1 + 0·14a_X$
"	" × 1	276½	80·1	"	**4·94**	8·32	**2·76**	2·45	**$1 + 0·37a_Y$**	$1 + 0·15a_X$
"	16 × ⅞	249	72·1	8	**4·40**	8·15	**2·77**	2·47	**$1 + 0·42a_Y$**	$1 + 0·15a_X$
"	" × ¾	235½	68·1	"	**4·38**	8·01	**2·78**	2·47	**$1 + 0·42a_Y$**	$1 + 0·15a_X$
"	" × ⅝	222	64·1	"	**4·37**	7·93	**2·79**	2·47	**$1 + 0·42a_Y$**	$1 + 0·16a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base &c. to be added.

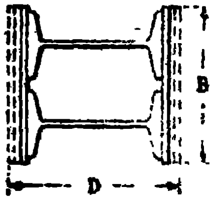
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	10	12	14	16	18	20	22	24	28	32	36	40
		HEIGHTS IN FEET.											
218 M	19 × 16	491	480	469	457	446	434	423	411	389	366	343	320
216 M	18½ × „	445	434	424	413	403	393	382	372	351	330	309	289
214 M	18 × „	398	388	379	370	360	351	342	332	314	295	276	257
213 M	17¾ × 14	348	339	329	320	310	300	291	281	262	243	224	205
212 M	17½ × „	328	319	310	301	292	283	274	265	247	229	211	193
211 M	17¼ × „	308	299	291	282	274	265	257	249	232	215	198	181
210 M	17 × „	288	280	272	264	256	248	240	232	216	200	194	168
198 M	18 × 16	481	470	459	448	437	425	414	403	381	358	336	314
196 M	17½ × „	434	424	414	404	394	384	374	364	343	323	303	283
194 M	17 × „	388	378	369	360	351	342	333	324	306	288	269	251
193 M	16¾ × 14	338	329	320	311	301	292	283	274	255	237	219	200
192 M	16½ × „	318	309	301	292	283	275	266	257	240	222	205	188
191 M	16¼ × „	298	290	282	273	265	257	249	241	224	208	192	175
190 M	16 × „	278	270	262	255	247	240	232	224	209	194	178	163
184 M	17 × 14	301	293	285	276	268	260	252	244	227	211	194	178
183 M	16¾ × „	281	273	266	258	250	242	235	227	212	196	181	166
182 M	16½ × „	261	254	246	239	232	225	218	211	196	182	168	153
181 M	16¼ × „	241	234	227	221	214	207	201	194	181	167	154	141
180 M	16 × „	220	214	208	202	196	190	184	178	165	153	141	128

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

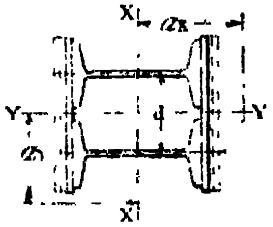
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS.



Composition and Properties.

Composed of		Weight per foot in lbs.	Area in square inches.	d. Centres of Webs in inches.	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Joists.	Plates, each flange to form.				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
16 × 6	16 × 1½	289½	84·4	8	**4·42**	7·80	**2·74**	2·49	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}16a_X$
"	" × 1¼	262½	76·4	"	**4·41**	7·61	**2·76**	2·48	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}16a_X$
"	" × 1	235	68·4	"	**4·39**	7·42	**2·78**	2·47	**$1+0{\cdot}42a_Y$**	$1+0{\cdot}17a_X$
"	14 × ⅞	210	60·9	7	**3·84**	7·24	**2·79**	2·50	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}17a_X$
"	" × ¾	198	57·4	"	**3·83**	7·13	**2·80**	2·51	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}17a_X$
"	" × ⅝	186	53·9		**3·82**	7·02	**2·81**	2·51	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ½	174	50·4	"	**3·80**	6·90	**2·83**	2·52	**$1+0{\cdot}49a_Y$**	$1+0{\cdot}18a_X$
15 × 6	16 × 1½	283½	82·7	8	**4·44**	7·40	**2·72**	2·48	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}17a_X$
"	" × 1¼	256½	74·7	"	**4·43**	7·23	**2·74**	2·47	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}17a_X$
"	" × 1	229½	66·7		**4·40**	7·04	**2·75**	2·46	**$1+0{\cdot}41a_Y$**	$1+0{\cdot}17a_X$
"	14 × ⅞	204	59·2	7	**3·86**	6·88	**2·76**	2·48	**$1+0{\cdot}47a_Y$**	$1+0{\cdot}18a_X$
"	" × ¾	192	55·7	"	**3·84**	6·78	**2·78**	2·48	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ⅝	180	52·2	"	**3·83**	6·67	**2·79**	2·48	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ½	168	48·7	"	**3·82**	6·56	**2·80**	2·49	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}19a_X$
15 × 5	14 × 1	181½	52·7	7	**3·85**	7·09	**2·75**	2·44	**$1+0{\cdot}47a_Y$**	$1+0{\cdot}17a_X$
"	" × ⅞	170	49·2	"	**3·84**	6·98	**2·76**	2·44	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}17a_X$
"	" × ¾	158	45·7	"	**3·82**	6·87	**2·78**	2·44	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ⅝	146	42·2	"	**3·81**	6·75	**2·79**	2·45	**$1+0{\cdot}48a_Y$**	$1+0{\cdot}18a_X$
"	" × ½	134	38·7	"	**3·78**	6·62	**2·81**	2·46	**$1+0{\cdot}49a_Y$**	$1+0{\cdot}18a_X$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

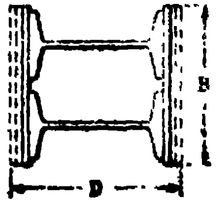
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches	HEIGHTS IN FEET. 10	12	14	16	18	20	22	24	28	32	36	40
168 M	17 × 16	475	464	453	442	431	420	409	398	376	354	332	310
166 M	16½ × "	428	418	408	398	388	378	368	358	338	318	298	279
164 M	16 × "	381	372	363	354	345	336	327	319	301	283	265	247
163 M	15¾ × 14	332	323	314	305	296	287	278	269	251	233	215	197
162 M	15½ × "	312	303	295	286	278	269	261	252	235	218	201	184
161 M	15¼ × "	291	283	275	267	259	251	243	235	220	204	188	172
160 M	15 × "	271	264	256	248	241	234	226	219	204	189	174	159
148 M	17 × 16	437	427	417	407	397	387	377	366	346	326	306	286
146 M	16½ × "	390	381	372	363	354	345	336	327	309	291	273	255
144 M	16 × "	343	335	327	319	311	303	295	287	271	255	239	223
143 M	15¾ × 14	295	287	279	271	263	255	247	239	223	207	191	175
142 M	15½ × "	275	267	260	252	245	237	230	222	207	193	178	163
141 M	15¼ × "	254	248	241	234	227	220	213	206	192	178	164	150
140 M	15 × "	235	228	221	215	208	202	196	189	176	164	151	138
128 M	15 × 14	422	411	400	388	377	366	355	343	321	298	276	253
126 M	14½ × "	382	372	362	351	341	331	321	310	290	269	249	228
124 M	14 × "	342	333	323	314	305	296	286	277	259	240	222	203
123 M	13¾ × "	322	313	304	295	287	278	269	261	243	226	208	191
122 M	13½ × "	302	293	285	277	269	261	252	244	228	211	195	179
121 M	13¼ × "	281	274	266	258	251	243	235	228	212	197	182	166
120 M	13 × "	261	254	247	240	233	225	218	211	197	182	168	154

Rivets ⅞ in. diam. at 6-in. pitch.

The above safe loads are calculated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

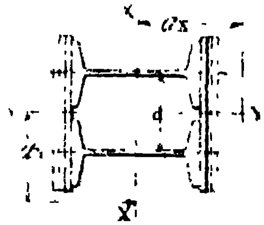
For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight per foot in lbs	Area in square inches	d Centres of Webs in inches	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Joists.	Plates, each flange to form.				Axis Y – Y	Axis X X	Web.	Flange.	Axis Y – Y	Axis X – X
14 × 6*a*	16 × 1½	279½	81·5	8	**4·45**	6·97	**2·72**	2·49	**1 + 0·41a_Y**	1 + 0·18a_X
"	" × 1¼	252½	73·5	"	**4·43**	6·79	**2·73**	2·48	**1 + 0·41a_Y**	1 + 0·18a_X
"	" × 1	225½	65·5	"	**4·41**	6·61	**2·75**	2·46	**1 + 0·41a_Y**	1 + 0·18a_X
"	14 × ⅞	200	58·0	7	**3·86**	6·46	**2·76**	2·49	**1 + 0·47a_Y**	1 + 0·19a_X
"	" × ¾	188	54·5	"	**3·85**	6·36	**2·77**	2·48	**1 + 0·47a_Y**	1 + 0·19a_X
"	" × ⅝	176	51·0	"	**3·84**	6·26	**2·78**	2·48	**1 + 0·48a_Y**	1 + 0·20a_X
"	" × ½	164	47·5		**3·82**	6·15	**2·80**	2·49	**1 + 0·48a_Y**	1 + 0·20a_X
14 × 6*b*	16 × 1½	257½	75·0	8	**4·47**	7·09	**2·68**	2·44	**1 + 0·40a_Y**	1 + 0·17a_X
"	" × 1¼	230½	67·0	"	**4·45**	6·92	**2·70**	2·42	**1 + 0·41a_Y**	1 + 0·17a_X
"	" × 1	203½	59·0	"	**4·43**	6·74	**2·72**	2·41	**1 + 0·41a_Y**	1 + 0·18a_X
"	14 × ⅞	178	51·5	7	**3·87**	6·59	**2·73**	2·43	**1 + 0·47a_Y**	1 + 0·18a_X
"	" × ¾	166	48·0		**3·86**	6·49	**2·74**	2·43	**1 + 0·47a_Y**	1 + 0·19a_X
"	" × ⅝	154	44·5	"	**3·85**	6·38	**2·75**	2·43	**1 + 0·47a_Y**	1 + 0·19a_X
"	" × ½	142	41·0	"	**3·83**	6·27	**2·76**	2·43	**1 + 0·48a_Y**	1 + 0·19a_X
12 × 6*a*	14 × 1½	253½	73·7	7	**3·91**	6·02	**2·71**	2·55	**1 + 0·46a_Y**	1 + 0·21a_X
"	" × 1¼	229½	66·7	"	**3·90**	5·86	**2·72**	2·53	**1 + 0·46a_Y**	1 + 0·21a_X
"	" × 1	205½	59·7	"	**3·88**	5·69	**2·74**	2·51	**1 + 0·47a_Y**	1 + 0·22a_X
"	" × ⅞	194	56·2	"	**3·87**	5·60	**2·75**	2·51	**1 + 0·47a_Y**	1 + 0·22a_X
"	" × ¾	182	52·7	"	**3·86**	5·51	**2·76**	2·50	**1 + 0·47a_Y**	1 + 0·22a_X
"	" × ⅝	170	49·2	"	**3·85**	5·42	**2·77**	2·49	**1 + 0·47a_Y**	1 + 0·23a_X
"	" × ½	158	45·7	"	**3·84**	5·32	**2·78**	2·49	**1 + 0·48a_Y**	1 + 0·23a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load, K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

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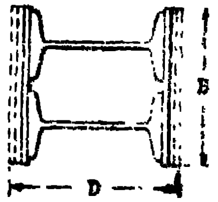


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET. 10	12	14	16	18	20	22	24	28	32	36	40
108 M	15 × 14	389	378	368	358	347	337	327	316	296	275	254	233
106 M	14½ × „	349	339	330	321	311	302	293	283	265	246	227	209
104 M	14 × „	308	300	292	284	275	267	259	250	231	217	201	184
103 M	13¾ × „	288	280	273	265	257	249	241	234	218	203	187	172
102 M	13½ × „	268	261	253	246	239	232	224	217	203	188	174	159
101 M	13¼ × „	248	241	234	228	221	214	207	201	187	174	160	147
100 M	13 × „	228	221	215	209	203	197	190	184	172	159	147	134
99 M	12¾ × „	208	202	196	190	185	179	173	168	156	145	133	122
94 M	14 × 12	239	232	224	216	209	201	193	185	170	155	139	124
93 M	13¾ × „	222	215	208	201	194	187	179	172	158	143	129	115
92 M	13½ × „	205	199	192	185	179	172	166	159	146	132	119	106
91 M	13¼ × „	189	182	176	170	164	158	152	146	133	121	109	96·9
90 M	13 × „	172	166	160	155	149	144	138	132	121	110	99·0	87·8
89 M	12¾ × „	155	150	145	139	134	129	124	119	109	99·0	88·8	78·0
78 M	13 × 14	382	372	362	352	342	331	321	311	291	270	250	230
76 M	12½ × „	342	333	324	315	305	296	287	278	260	242	223	205
74 M	12 × „	302	294	286	277	269	261	253	245	229	213	196	180
73 M	11¾ × „	282	274	266	259	251	244	236	229	213	198	183	*168*
72 M	11½ × „	261	254	247	240	233	226	219	212	198	184	170	*156*
71 M	11¼ × „	241	235	228	222	215	209	202	195	182	169	156	*143*
70 M	11 × „	221	215	209	203	197	191	185	179	167	155	143	*131*
69 M	10¾ × „	201	195	190	184	179	173	168	162	151	140	*129*	*118*

Rivets ⅞ in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

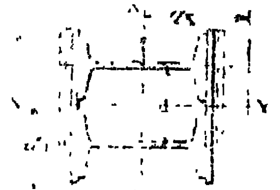
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.



Composition and Properties.

Composed of		Weight per foot in lbs.	Area in square inches.	d. Centres of Webs in inches.	Radii of Gyration				Eccentricity Coefficients.	
Two Steel Joists.	Plates, each flange to form.				Axis Y—Y	Axis X-X	Web.	Flange.	Axis Y—Y	Axis X—X
12 × 6 b	14 × 1½	233½	67·9	7	**3·93**	6·15	2·68	[illegible]	**1 + 0·46a_Y**	1 + 0·20a_X
"	" × 1¼	209½	60·9	"	**3·91**	5·97	2·69	[illegible]	**1 + 0·46a_Y**	1 + 0·21a_X
"	" × 1	185½	53·9	"	**3·90**	5·80	2·71	[illegible]	**1 + 0·46a_Y**	1 + 0·21a_X
"	" × ⅞	174	50·4	"	**3·89**	5·72	2·72	[illegible]	**1 + 0·47a_Y**	1 + 0·21a_X
"	" × ¾	162	46·9	"	**3·87**	5·6[illegible]	2·73	[illegible]	**1 + 0·47a_Y**	1 + 0·22a_X
"	" × ⅝	150	43·4	"	**3·86**	5·53	2·74	[illegible]	**1 + 0·47a_Y**	1 + 0·22a_X
"	" × ½	140	39·9	"	**3·84**	5·43	2·75	[illegible]	**1 + 0·48a_Y**	1 + 0·22a_X
"	" × ⅜	126	36·4	"	**3·83**	5·32	2·77	[illegible]	**1 + 0·48a_Y**	1 + 0·23a_X
12 × 5	12 × 1	148	42·8	"	**3·33**	5·8[illegible]	2·71	2·4[illegible]	**1 + 0·54a_Y**	1 + 0·21a_X
"	" × ⅞	138	39·8	"	**3·32**	5·71	2·72	[illegible]	**1 + 0·54a_Y**	1 + 0·21a_X
"	" × ¾	127¾	36·8	"	**3·31**	5·64	2·73	[illegible]	**1 + 0·55a_Y**	1 + 0·21a_X
"	" × ⅝	117¾	33·8	"	**3·30**	[illegible]	2·75	[illegible]	**1 + 0·55a_Y**	1 + 0·22a_X
"	" × ½	107½	30·8	"	**3·28**	5·43	2·76	[illegible]	**1 + 0·56a_Y**	1 + 0·22a_X
"	" × ⅜	97	27·8	"	**3·26**	5·31	2·79	[illegible]	**1 + 0·56a_Y**	1 + 0·23a_X
10 × 6	14 × 1½	229½	66·7	7	**3·94**	5·22	2·67	2·55	**1 + 0·45a_Y**	1 + 0·24a_X
"	" × 1¼	205½	59·7	"	**3·92**	5·07	2·68	2·52	**1 + 0·46a_Y**	1 + 0·25a_X
"	" × 1	181½	52·7	"	**3·91**	4·91	2·70	[illegible]	**1 + 0·46a_Y**	1 + 0·25a_X
"	" × ⅞	170	49·2	"	**3·90**	4·82	2·71	[illegible]	**1 + 0·46a_Y**	1 + 0·25a_X
"	" × ¾	158	45·7	"	**3·89**	4·7[illegible]	2·71	[illegible]	**1 + 0·46a_Y**	1 + 0·26a_X
"	" × ⅝	146	42·2		**3·87**	4·6[illegible]	2·73	[illegible]	**1 + 0·47a_Y**	1 + 0·26a_X
"	" × ½	134	38·7		**3·8[illegible]**	4·57	2·7[illegible]	[illegible]	**1 + 0·47a_Y**	1 + 0·27a_X
"	" × ⅜	122	35·2	"	**3·84**	4·47	2·7[illegible]	[illegible]	**1 + 0·48a_Y**	1 + 0·27a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of [illegible], &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value: Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

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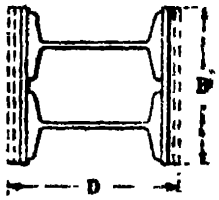


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		10	12	14	16	18	20	22	24	28	32	36	40
64 M	12 × 12	233	225	218	210	203	195	188	181	166	151	136	121
63 M	11¾ × „	216	209	202	195	188	181	174	167	153	139	126	*112*
62 M	11½ × „	199	193	186	180	173	167	160	154	141	128	115	*103*
61 M	11¼ × „	182	176	170	164	158	153	147	141	129	117	105	*94·0*
60 M	11 × „	165	160	154	149	144	138	133	127	117	106	95·6	*84·8*
59 M	10¾ × „	148	143	138	134	129	124	119	114	104	95·1	*85·3*	*75·6*
50 M	10 × 10	120	116	111	106	101	96·5	91·6	86·7	76·9	67·1	57·4	
49 M	9¾ × „	107	102	98·5	94·1	89·7	85·4	81·0	76·7	67·9	59·2	50·7	
38 M	11 × 11	359	349	340	330	321	311	302	292	273	254	235	*216*
36 M	10½ × „	318	310	301	293	284	276	267	259	242	225	*208*	*191*
34 M	10 × „	278	271	263	256	248	241	233	226	211	196	*181*	*166*
33 M	9¾ × „	258	251	244	237	230	223	216	210	196	182	*168*	*154*
32 M	9½ × „	238	231	225	218	212	205	199	193	180	*167*	*154*	*141*
31 M	9¼ × „	217	211	205	199	193	187	181	175	163	*151*	*139*	*127*
30 M	9 × „	196	191	185	179	174	168	163	157	146	*135*	*123*	*112*
29 M	8¾ × „	176	171	165	160	155	150	145	140	131	*120*	*109*	*98·8*
22 M	9½ × 12	193	187	180	174	168	162	156	149	137	*125*	*112*	*100*
21 M	9¼ × „	176	170	164	159	153	147	142	136	125	*113*	*102*	*91·1*
20 M	9 × „	159	154	149	143	138	133	128	123	112	*102*	*92·3*	*82·0*
19 M	8¾ × „	142	137	133	128	123	119	114	109	100	*91·4*	*82·1*	*72·8*
10 M	9 × 10	111	106	102	97·8	93·5	89·0	84·5	80·0	71·1	*62·1*	*53·2*	
9 M	8¾ × „	97·7	93·8	89·8	85·9	81·9	77·9	74·0	70·0	62·1	*54·2*	*46·3*	

Rivets ⅞-in. diam at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 100

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having " both ends fixed "

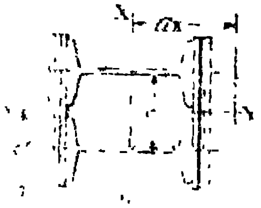
For other conditions and formulæ, see notes commencing page 192 L

Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS.



Composition and Properties

Composed of: Two Steel Joists.	Composed of: Plates each flange to form.	Weight per foot in lbs.	Area [illegible]	[illegible]	Radii of Gyration: [illegible]	Radii of Gyration: [illegible]	[illegible]	[illegible]	Eccentricity coefficients. Axis Y-Y	Eccentricity coefficients. Axis X-X
10 × 5	12 × 1	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·54a_y	1 + 0·25a_x
"	" × ¾	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·54a_y	1 + 0·25a_x
"	" × ⅝	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·54a_y	1 + 0·25a_x
"	" × ½	113½	32·6		3·31	[illegible]	2·74	[illegible]	1 + 0·55a_y	1 + 0·26a_x
"	" × ⅜	103½	[illegible]		3·29	4·58	[illegible]	[illegible]	1 + 0·55a_y	1 + 0·26a_x
"	" × ¼	93	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·56a_y	1 + 0·27a_x
9 × 4	[illegible]	[illegible]	[illegible]		[illegible]	4·16	[illegible]	[illegible]	1 + 0·66a_y	1 + 0·29a_x
"	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·67a_y	1 + 0·30a_x
8 × 6	[illegible]	[illegible]	[illegible]		3·94	[illegible]	[illegible]	[illegible]	1 + 0·45a	1 + 0·29a_x
"	" × 1¼	[illegible]	[illegible]		3·93	[illegible]	[illegible]	[illegible]	1 + 0·45a_y	1 + 0·30a_x
"	" × 1	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·46a_y	1 + 0·31a_x
"	" × ⅞	156	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·46a_y	1 + 0·31a_x
"	" × ¾	144	[illegible]		[illegible]	3·87	[illegible]	2·51	1 + 0·46a_y	1 + 0·32a_x
"	" × ⅝	132	[illegible]		[illegible]	3·79	[illegible]	2·19	1 + 0·47a_y	1 + 0·32a_x
"	" × ½	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·47a_y	1 + 0·33a_x
"	" × ⅜	108	31·1		[illegible]	3·61	[illegible]	[illegible]	1 + 0·48a_y	1 + 0·34a_x
8 × 5	12 × ¾	119½	[illegible]		3·34	[illegible]	[illegible]	[illegible]	1 + 0·54a_y	1 + 0·31a_x
"	" × ⅝	109½	31·5		[illegible]	[illegible]	[illegible]	[illegible]	1 + 0·54a_y	1 + 0·32a_x
"	" × ½	99½	28·5	"	3·31	[illegible]	2·74	[illegible]	1 + 0·55a_y	1 + 0·33a_x
"	" × ⅜	89	25·5	"	3·29	[illegible]	2·76	2·45	1 + 0·55a_y	1 + 0·33a_x
8 × 4	10 × ½	72½	20·6	5	2·76	[illegible]	2·74	2·45	1 + 0·66a_y	1 + 0·32a_x
"	" × ⅜	64	[illegible]	"	2·74	3·66	2·76	2·43	1 + 0·67a_y	1 + 0·33a_x

In each case the weight per foot given is the minimum that can be rolled and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted stanchion only. Weight of bases, &c. to be added.

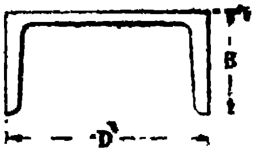
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We×K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



STANCHIONS.

Steel Channels.

Safe Concentric Loads, in Tons. Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	11	12	13
*27 N	15 × 4	73·3	69·9	66·5	63·1	59·7	56·3	52·9	49·5	46·1	42·6	39·2	35·8
26 N	12 × 4	64·0	61·1	58·3	55·4	52·6	49·7	46·9	44·0	41·1	38·3	35·4	32·6
*25 N	12 × 3½	56·8	53·7	50·7	47·7	44·7	41·7	38·6	35·6	32·6	29·6	*26·6*	
*24 N	12 × 3½	45·2	42·9	40·6	38·2	35·9	33·6	31·3	29·0	26·7	24·3	*22·0*	*19·7*
23 N	11 × 4	58·3	55·8	53·2	50·7	48·1	45·5	43·0	40·4	37·9	35·3	32·7	30·2
22 N	11 × 3½	51·6	48·9	46·2	43·5	40·9	38·2	35·5	32·8	30·1	27·4	*24·7*	*22·1*
21 N	10 × 4	53·0	50·8	48·5	46·2	43·9	41·6	39·3	37·0	34·8	32·5	30·2	27·9
*20 N	10 × 3½	48·9	46·4	43·9	41·4	38·9	36·4	33·8	31·3	28·8	26·3	*23·8*	*21·3*
19 N	10 × 3½	40·9	38·8	36·8	34·8	32·7	30·7	28·7	26·6	24·6	22·5	*20·5*	*18·5*
18 N	9 × 4	50·2	48·1	46·0	43·8	41·7	39·5	37·4	35·3	33·1	31·0	28·8	26·7
*17 N	9 × 3½	44·1	41·9	39·7	37·4	35·2	33·0	30·8	28·6	26·4	24·2	*22·0*	*19·8*
*16 N	9 × 3½	38·7	36·8	34·9	33·0	31·1	29·2	27·3	25·4	23·5	21·6	*19·7*	*17·8*
15 N	9 × 3	32·9	30·9	28·8	26·8	24·8	22·7	20·7	18·7	16·6	*14·6*		
14 N	8 × 4	45·3	43·4	41·5	39·6	37·7	35·8	33·9	32·0	20·1	28·2	26·3	24·4

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

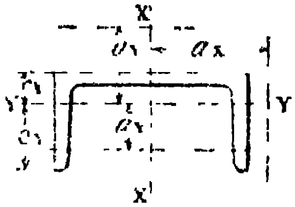
Safe loads printed in italics are for heights greater than 40B.

For explanations of properties, &c., see Part IV.

STANCHIONS.

Steel Channels.

Dimensions and Properties.



Size, D × B inches.	Weight per foot in lbs.	Area in square inches.	Distance e_Y inches	Radii of Gyration.		Eccentricity Coefficients.				
				Axis Y—Y	Axis X—X	Web.	Flange	Axis Y—Y e_Y	Axis Y—Y c_Y	Axis X—X
*15 × 4	41·94	12·334	3·065	**1·08**	5·55	1·73	2·84	**1 + 2·60a_y**	1 + 0·79a_y	1 + 0·25a_x
12 × 4	36·47	10·727	2·969	**1·13**	4·51	[illegible]	2·77	**1 + 2·34a_y**	1 + 0·81a_y	1 + 0·30a_x
*12 × 3½	32·88	9·671	2·633	**0·96**	4·44	1·32	2·83	**1 + 2·86a_y**	1 + 0·94a_y	1 + 0·31a_x
*12 × 3½	26·10	7·675	2·640	**0·99**	4·54	**1·75**	2·74	**1 + 2·68a_y**	1 + 0·87a_y	1 + 0·29a_x
11 × 4	33·22	9·771	2·937	**1·14**	4·17	1·86	2·74	**1 + 2·24a_y**	1 + 0·81a_y	1 + 0·32a_x
11 × 3½	29·82	8·771	2·604	**0·98**	4·11	1·81	[illegible]	**1 + 2·71a_y**	1 + 0·93a_y	1 + 0·33a_x
10 × 4	30·16	8·871	2·898	**1·16**	3·84	1·90	[illegible]	**1 + 2·14a_y**	1 + 0·82a_y	1 + 0·34a_x
*10 × 3½	28·21	8·296	2·567	**0·99**	3·77	1·82	2·76	**1 + 2·60a_y**	1 + 0·95a_y	1 + 0·35a_x
10 × 3½	23·55	6·925	2·567	**1·02**	3·85	**1·84**	2·69	**1 + 2·47a_y**	1 + 0·90a_y	1 + 0·34a_x
9 × 4	28·55	8·396	2·849	**1·17**	3·18	**1·96**	2·67	**1 + 2·06a_y**	1 + 0·83a_y	1 + 0·37a_x
*9 × 3½	25·39	7·465	2·529	**1·01**	3·45	**1·92**	2·72	**1 + 2·47a_y**	1 + 0·95a_y	1 + 0·38a_x
*9 × 3½	22·27	6·550	2·524	**1·03**	3·49	**1·90**	2·66	**1 + 2·33a_y**	1 + 0·92a_y	1 + 0·37a_x
9 × 3	19·37	5·696	2·246	**0·84**	3·38	**1·81**	2·77	**1 + 3·19a_y**	1 + 1·07a_y	1 + 0·40a_x
8 × 4	25·73	7·569	2·799	**1·19**	3·12	**2·01**	2·64	**1 + 1·97a_y**	1 + 0·84a_y	1 + 0·41a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

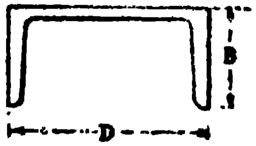
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value: Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

Sections marked (*) are in our stocks.

For full explanations of tables, see notes commencing page 192 L.



STANCHIONS.

Steel Channels.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B Inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	11	12	13
*13 N	8 × 3½	39·5	37·5	35·6	33·6	31·7	29·7	27·8	25·8	23·9	21·9	*20·0*	*18·1*
12 N	8 × 3	32·9	31·0	29·0	27·1	25·1	23·2	21·2	19·3	17·3	*15·4*		
11 N	8 × 2½	25·1	23·3	21·4	19·5	17·7	15·8	14·0	*12·1*				
*10 N	7 × 3½	35·2	33·5	31·8	30·1	28·4	26·7	25·0	23·3	21·5	19·8	*18·1*	*16·4*
9 N	7 × 3	30·0	28·3	26·5	24·7	23·0	21·2	19·5	17·7	16·0	*14·2*		
8 N	6 × 3½	31·2	29·7	28·2	26·7	25·2	23·7	22·2	20·8	19·3	17·8	*16·3*	*14·8*
*7 N	6 × 3	27·9	26·3	24·7	23·0	21·4	19·8	18·2	16·5	15·0	*13·4*		
*6 N	6 × 3	24·8	23·4	22·0	20·6	19·2	17·8	16·4	15·0	13·6	*12·1*	*11·7*	
5 N	6 × 2½	20·1	18·6	17·1	15·7	14·2	12·8	11·3	*9·9*				
*4 N	5 × 2½	18·3	17·0	15·7	14·4	13·1	11·8	10·5	*9·2*				
*3 N	4 × 2	12·8	11·7	10·5	9·3	8·1	*7·0*	*5·8*					
2 N	3½ × 2	10·9	9·9	8·9	7·9	6·9	*5·9*	*4·9*					
*1 N	3 × 1½	7·9	6·8	5·8	4·7								

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192L.

Safe loads printed in italics are for heights greater than 40B

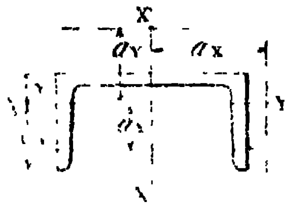
For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

STANCHIONS.

Steel Channels.

Dimensions and Properties.



Size, D × B inches.	Weight per foot in lbs	Area in square inches.	Distance e_Y inches.	Radii of Gyration.		Eccentricity Coefficients				
				Axis Y—Y	Axis X—X	Web.	Flange	Axis Y—Y e_X	Axis Y—Y e_Y	Axis X—X
*8 × 3½	22·72	6·682	2·489	1·03	3·09	1·97	2·68	1 + 2·36a_Y	1 + 0·96a_Y	1 + 0·42a_X
8 × 3	19·30	5·675	2·156	0·87	3·07	1·94	2·70	1 + 2·83a_Y	1 + 1·11a_Y	1 + 0·43a_X
8 × 2½	15·12	4·448	1·834	0·71	3·01	1·87	2·73	1 + 3·58a_Y	1 + 1·30a_Y	1 + 0·43a_X
*7 × 3½	20·23	5·950	2·439	1·04	2·73	2·03	2·64	1 + 2·24a_Y	1 + 0·97a_Y	1 + 0·47a_X
7 × 3	17·56	5·166	2·126	0·88	2·70	1·98	2·68	1 + 2·74a_Y	1 + 1·13a_Y	1 + 0·48a_X
6 × 3½	17·90	5·266	2·381	1·06	2·37	2·12	2·66	1 + 2·12a_Y	1 + 1·00a_Y	1 + 0·53a_X
*6 × 3	16·29	4·791	2·072	0·89	2·33	2·08	2·66	1 + 2·60a_Y	1 + 1·17a_Y	1 + 0·55a_X
*6 × 3	14·49	4·261	2·062	0·90	2·37	2·07	2·60	1 + 2·51a_Y	1 + 1·14a_Y	1 + 0·53a_X
6 × 2½	12·04	3·542	1·796	0·73	2·30	1·93	2·70	1 + 3·38a_Y	1 + 1·83a_Y	1 + 0·57a_X
*5 × 2½	10·98	3·230	1·743	0·74	1·94	2·05	2·67	1 + 3·18a_Y	1 + 1·38a_Y	1 + 0·67a_X
*4 × 2	7·96	2·341	1·344	0·60	1·56	2·20	2·64	1 + 3·74a_Y	1 + 1·83a_Y	1 + 0·82a_X
3½ × 2	6·75	1·986	1·355	0·60	1·36	2·16	2·65	1 + 3·78a_Y	1 + 1·80a_Y	1 + 0·94a_X
*3 × 1½	5·27	1·549	1·016	0·43	1·13	2·23	2·68	1 + 5·32a_Y	1 + 2·54a_Y	1 + 1·12a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

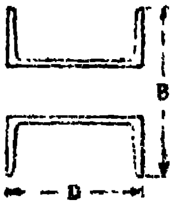
We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

Sections marked (*) are in our stocks.

For full explanations of tables, see notes commencing page 192 L.

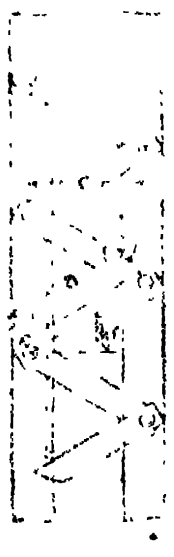
REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS.

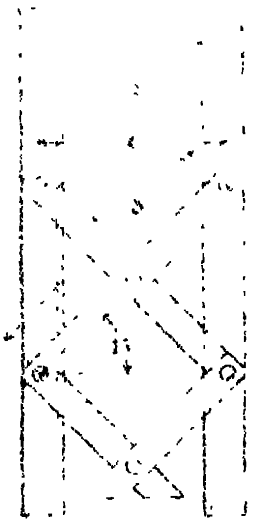
Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches	HEIGHTS IN FEET.											
		10	12	14	16	18	20	22	24	28	32	36	40
25 O	12 × 13	111	108	105	102	99·5	96·5	93·6	90·7	84·9	79·1	73·2	67·4
20 O	10 × 12	93·9	91·1	88·3	85·5	82·7	79·9	77·2	74·4	68·8	63·2	*57·7*	*52·1*
17 O	9 × 11	82·8	79·9	77·1	74·2	71·4	68·5	65·6	62·8	57·1	*51·4*	*45·7*	*39·9*
13 O	8 × 10	72·0	69·1	66·2	63·2	60·3	57·3	54·3	51·3	*45·4*	*39·5*	*33·6*	*27·7*
10 O	7 × 9	61·9	58·8	55·7	52·6	49·5	46·4	43·3	*40·2*	*34·0*	*27·9*	*21·7*	*15·5*

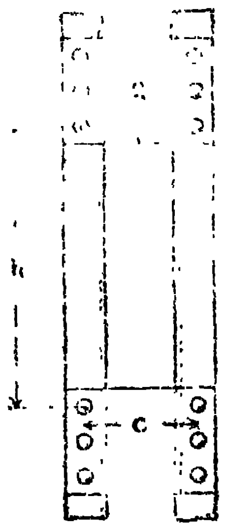


SINGLE LATTICING

Suitable for values of C not exceeding [illegible] inches.



DOUBLE LATTICING



BATTEN PLATES.

The above safe loads are tabulated for ratio of slenderness up to, but not exceeding 160.

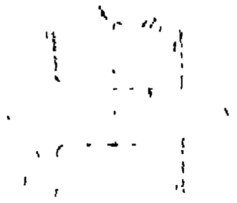
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having both ends fixed.

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 90r.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS.



Composition and Properties.

Composed of Two Steel Channels Latticed.	Weight per foot in lbs.	Area in square inches	1 Space between Webs. Inches	Radii of Gyration Axis Y–Y	Radii of Gyration Axis X–X	Eccentricity Coefficients Web.	Eccentricity Coefficients Flange	Eccentricity Coefficients Axis Y–Y	Eccentricity Coefficients Axis X–X
12 × 3½	66	19·3	6	3·98	4·44	3·15	2·83	1 + 0·41a_y	1 + 0·31a_x
10 × 3½	56½	16·6	5	3·57	3·77	3·22	2·76	1 + 0·47a_y	1 + 0·35a_x
9 × 3½	51	14·9	4	3·14	3·45	3·35	2·72	1 + 0·56a_y	1 + 0·38a_x
8 × 3½	45½	13·3	3	2·71	3·09	3·50	2·68	1 + 0·68a_y	1 + 0·42a_x
7 × 3½	40½	11·9	2	2·31	2·73	3·66	2·64	1 + 0·84a_y	1 + 0·47a_x

Conventional Maximum Spacing and Minimum Proportions of Lattice Bars and Batten Plates for Concentric Loading (*Am. Ry. Engineers, and Maintenance of Way Assoc.*)

Depth of Channel, Inches.	12	10	9	8	7
Width of Lattice Bar, Inches	2½	2½	2¼	2¼	2
Diameter of Rivet.	¾	¾	¾	¾	⅝

Single Latticing—

Maximum angle of inclination with horizontal = 30 degrees
Minimum thickness = 1/40th of *a*, the diagonal centres of rivets
Maximum horizontal centres of rivets, *c* = 5 inches

Double Latticing—

Maximum angle of inclination with horizontal = 45 degrees
Minimum thickness = 1/60th of *a*, the diagonal centres of rivets

Batten Plates—

Maximum centres of end rivets of batten plates = *h* inches
Let *l* = height of stanchion in inches, and *k* = radius of gyration of one channel.

Then $h = \dfrac{l \times k \text{ least}}{k \text{ greatest}}$.

Minimum thickness = 1/50th of *c*, the horizontal centres of rivets.
Minimum width *g* = *c*, the horizontal centres of rivets for end plates.
" " *g* = ⅔*c*, " " " intermediate plates.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed, see page 7

Each weight per foot is for the shaft only. Weights of lattices, base, &c, to be added

Least radii of gyration and relative eccentricity coefficients are printed in prominent type

We = actual eccentric load, K = relative eccentricity coefficient; Wc = equivalent concentric value, Wc = We × K

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192 L.

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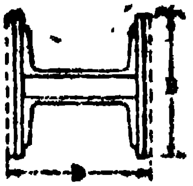


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons. Ends Fixed.

Reference Mark	Size, D × B inches.	HEIGHTS IN FEET.											
		10	11	12	13	14	16	18	20	24	28	32	36
58 P	15 × 14	348	343	338	333	328	318	309	299	279	259	239	219
56 P	14½ × "	308	304	299	295	290	281	272	263	245	227	210	192
54 P	14 × "	268	264	260	256	252	244	236	228	212	196	180	165
53 P	13¾ × "	247	244	240	236	232	225	218	210	195	181	166	151
52 P	13½ × "	227	224	220	217	213	206	199	192	179	165	151	137
51 P	13¼ × "	207	204	200	197	194	188	181	175	162	149	136	123
50 P	13 × "	187	184	181	178	175	169	163	157	145	133	121	109
49 P	12¾ × 12	153	150	146	143	140	134	128	122	109	97·2	84·8	72·4
38 P	13 × 12	292	287	282	277	272	262	252	242	222	202	182	162
36 P	12½ × "	258	253	249	244	240	231	222	213	195	177	159	141
34 P	12 × "	224	220	216	212	208	200	192	184	168	152	137	121
33 P	11¾ × "	207	203	199	196	192	185	177	170	155	140	125	110
32 P	11½ × "	190	186	183	179	176	169	162	155	141	128	114	100
31 P	11¼ × "	173	170	166	163	160	154	147	141	128	115	102	89·8
30 P	11 × "	156	153	150	147	144	138	132	126	114	102	90·9	79·1
29 P	10¾ × 10	124	121	118	115	112	106	99·7	93·3	80·7	68·1		

Rivets ⅞-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

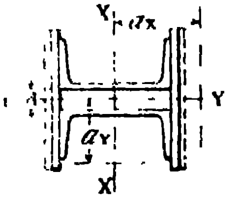
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS.



Composition and Properties.

Composed of		Weight per foot in lbs.	Area in square inches.	d Space between Webs in inches.	Radii of Gyration.		Eccentricity Coefficients.			
Two Steel Channels.	Plates, each flange to form				Axis Y—Y	Axis X—X	Web.	Flange.	Axis Y—Y	Axis X—X
12 × 3½	14 × 1½	211	61·3	3·5	3·80	6·12	2·16	2·50	$1+0{\cdot}52a_{Y}$	$1+0{\cdot}20a_{X}$
„	„ × 1¼	187½	54·3	„	3·64	5·91	2·19	2·49	$1+0{\cdot}53a_{Y}$	$1+0{\cdot}21a_{X}$
„	„ × 1	163½	47·3	„	3·58	5·75	2·23	2·48	$1+0{\cdot}55a_{Y}$	$1+0{\cdot}21a_{X}$
„	„ × ⅞	150	43·8	„	3·54	5·64	2·26	2·48	$1+0{\cdot}56a_{Y}$	$1+0{\cdot}22a_{X}$
„	„ × ¾	139½	40·3	„	3·49	5·53	2·29	2·49	$1+0{\cdot}57a_{Y}$	$1+0{\cdot}22a_{X}$
„	„ × ⅝	128	36·8	„	3·44	5·41	2·33	2·50	$1+0{\cdot}59a_{Y}$	$1+0{\cdot}23a_{X}$
„	„ × ½	116	33·3	„	3·37	5·28	2·39	2·52	$1+0{\cdot}62a_{Y}$	$1+0{\cdot}24a_{X}$
„	12 × ⅜	99	28·3	2·5	2·74	5·06	2·40	2·59	$1+0{\cdot}80a_{Y}$	$1+0{\cdot}25a_{X}$
10 × 3½	12 × 1½	181½	52·6	2·5	3·16	5·29	2·03	2·51	$1+0{\cdot}60a_{Y}$	$1+0{\cdot}23a_{X}$
„	„ × 1¼	161	46·6	„	3·12	5·05	2·06	2·53	$1+0{\cdot}62a_{Y}$	$1+0{\cdot}25a_{X}$
„	„ × 1	140½	40·6	„	3·07	4·87	2·10	2·52	$1+0{\cdot}64a_{Y}$	$1+0{\cdot}25a_{X}$
„	„ × ⅞	130½	37·6	„	3·04	4·78	2·12	2·51	$1+0{\cdot}65a_{Y}$	$1+0{\cdot}26a_{X}$
„	„ × ¾	120	34·6	„	3·00	4·68	2·15	2·51	$1+0{\cdot}67a_{Y}$	$1+0{\cdot}26a_{X}$
„	„ × ⅝	110	31·6	„	2·95	4·57	2·19	2·52	$1+0{\cdot}69a_{Y}$	$1+0{\cdot}27a_{X}$
„	„ × ½	99½	28·6	„	2·89	4·45	2·24	2·53	$1+0{\cdot}72a_{Y}$	$1+0{\cdot}28a_{X}$
„	10 × ⅜	84½	24·1	2·5	2·28	4·26	2·17	2·59	$1+0{\cdot}96a_{Y}$	$1+0{\cdot}30a_{X}$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load: K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192L.

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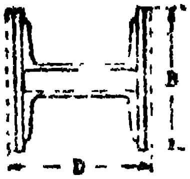


COMPOUND STANCHIONS.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark	Size D × B inches	HEIGHTS IN FEET. 10	11	12	13	14	16	18	20	24	28	32	36
24 P	11 × 12	215	211	207	204	200	192	185	177	162	147	132	117
23 P	10¾ × „	198	195	191	188	184	177	170	163	149	135	121	*107*
22 P	10½ × „	181	178	175	171	168	162	155	149	136	123	110	*97·7*
21 P	10¼ × „	164	161	158	155	152	146	140	134	122	110	98·7	*86·7*
20 P	10 × „	147	144	142	139	136	131	125	120	109	98·1	87·2	*76·2*
19 P	9¾ × 10	116	114	111	108	105	99·6	93·8	88·0	76·5	65·0		
14 P	10 × 10	178	174	170	166	162	154	147	139	123	108	92·8	
13 P	9¾ × „	164	160	157	153	149	142	135	128	113	99·1	84·6	
12 P	9½ × „	150	147	143	140	137	130	123	116	103	89·9	*76·4*	
11 P	9¼ × „	136	133	130	127	124	118	111	105	93·1	80·6	*68·2*	
10 P	9 × „	123	120	117	114	111	105	100	94·4	82·9	71·4	*59·9*	
9 P	8¾ × 9	102	99·3	96·5	93·6	90·8	85·1	79·4	73·7	62·3	50·9		

Rivets ⅞-in diam. at 6-in pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

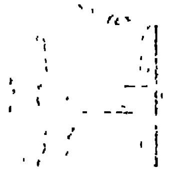
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS.

Composition and Properties.



Composed of		Weight [illegible]	[illegible]	[illegible] Weight [illegible]	[illegible] Gyr[illegible]				Eccentricity Coefficients	
Two Steel Channels	[illegible] each [illegible]	foot in lb.	[illegible]	[illegible]	Axis Y-Y	Axis X-X	[illegible]	Flange	Axis Y-Y	Axis X-X
9 × 3½	12 × 1	13[illegible]	[illegible]	[illegible]	[illegible]	[illegible]·47	2·[illegible]	2·[illegible]2	$1+0{\cdot}62a_y$	$1+0{\cdot}28a_x$
"	" × ⅞	124¼	[illegible]	"	[illegible]	[illegible]·38	2·[illegible]5	2·51	$1+0{\cdot}63a_y$	$1+0{\cdot}28a_x$
"	" × ¾	114½	[illegible]	[illegible]	[illegible]	[illegible]·28	2·10	2·[illegible]	$1+0{\cdot}65a_y$	$1+0{\cdot}29a_x$
"	" × ⅝	104[illegible]	[illegible]	"	[illegible]	[illegible]	2·[illegible]1	2·5[illegible]	$1+0{\cdot}67a_y$	$1+0{\cdot}30a_x$
"	" × ½	94	2[illegible]		2·5[illegible]	[illegible]	2·18	2·51	$1+0{\cdot}70a_y$	$1+0{\cdot}30a_x$
"	11 × [illegible]	7[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2·11	2·5[illegible]	$1+0{\cdot}92a_y$	$1+0{\cdot}32a_x$
[illegible] × 3½	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]8	2·5[illegible]	$1+0{\cdot}75a_y$	$1+0{\cdot}31a_x$
"	[illegible] ⅞	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1·9[illegible]	[illegible]	$1+0{\cdot}77a_y$	$1+0{\cdot}32a_x$
"	[illegible] × ¾	[illegible]	[illegible]		[illegible]	[illegible]	1·9[illegible]	[illegible]	$1+0{\cdot}79a_y$	$1+0{\cdot}33a_x$
"	" × ⅝	90½	25·8	"	2·[illegible]	[illegible]	1·95	2·54	$1+0{\cdot}81a_y$	$1+0{\cdot}33a_x$
"	" × ½	82	23·5	"	2·44	[illegible]	1·99	2·54	$1+0{\cdot}84a_y$	$1+0{\cdot}34a_x$
"	9 × ⅝	71	20·1	½	2·12	3·49	1·93	2·57	$1+1{\cdot}01a_y$	$1+0{\cdot}36a_x$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this has to be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of base &c. to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W = actual eccentric load, [illegible] relative eccentricity coefficient, We = equivalent concentric load, We = W × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables see notes commencing page 192 L.

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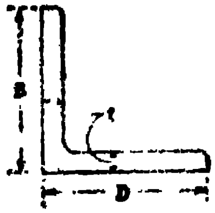

STANCHIONS (or STRUTS).
Steel Equal Angles.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark	Size D × B × t inches	HEIGHTS IN FEET. 2	3	4	5	6	7	8	9	10	11	12	14
14*g* Q	6 × 6 × ¾	50·5	48·3	46·2	44·0	41·8	39·7	37·5	35·3	33·2	31·0	28·9	24·6
14*f* Q	" × ⅝	42·6	40·8	39 0	37·2	35·3	33·5	31·7	29·9	28 1	26·3	24·5	20·9
14*e* Q	" × ½	34·4	33·0	31·5	30·0	28·6	27·1	25·7	24·2	22·7	21·3	19·8	16·9
13*g* Q	5 × 5 × ¾	40·7	38·5	36·4	34·2	32·0	29·9	27·7	25·5	23·4	21·2	19·0	
13*f* Q	" × ⅝	34·4	32·7	30·9	29·1	27·3	25·5	23·7	21·9	20·1	18·3	16 5	
13*e* Q	" × ½	27·9	26·5	25·0	23·6	22·1	20·7	19·2	17·7	16·3	14·8	13 4	
12*g* Q	4½ × 4½ × ¾	35·8	33·6	31·4	29·3	27·1	24·9	22·7	20 5	18 3	16·2		
12*f* Q	" × ⅝	30·4	28·6	26·8	25·0	23·2	21·4	19·5	17·7	15·9	14 1		
12*e* Q	" × ½	24·7	23·2	21·7	20·3	18·8	17·3	15·9	14·4	12·9	11·5		
11*g* Q	4 × 4 × ¾	31·0	28·8	26·6	24·5	22·3	20·1	17·9	15·7	13·5			
11*f* Q	" × ⅝	26 3	24·5	22·7	21·0	19·2	17·4	15·6	13·8	12·0			
11*e* Q	" × ½	21·4	19·9	18·5	17·0	15·6	14·1	12·6	11·2	9·7			
11*d* Q	" × ⅜	16·3	15·2	14·1	13·0	11·9	10·8	9·7	8·6	7·5			
10*f* Q	3½ × 3½ × ⅝	22·4	20·6	18·9	17·1	15·4	13·6	11·8	10·1				
10*e* Q	" × ½	18·2	16·8	15·4	13·9	12·5	11·0	9 6	8·2				
10*d* Q	" × ⅜	13·9	12·8	11·7	10·6	9·5	8·4	7·3	6·2				

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 100.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

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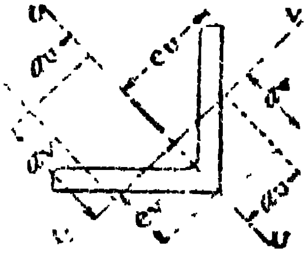
STANCHIONS (or STRUTS).

Steel Equal Angles.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches	Distances in Inches		Radii of Gyration		Eccentricity Coefficients.	
			e_v	e_u	Axis V—V	Axis U—U	Axis V—V	Axis U—U
6 × 6 × ¾	28·70	8·441	2·49	4·24	1·17	2·28	1 + 1·82 a_v	1 + 0·82 a_u
" × ⅝	24·13	7·113	2·42	4·24	1·18	2·30	1 + 1·74 a_v	1 + 0·81 a_u
" × ½	19·55	5·753	2·35	4·24	1·18	2·32	1 + 1·69 a_v	1 + 0·79 a_u
5 × 5 × ¾	23·59	6·938	2·14	3·54	0·96	1·88	1 + 2·32 a_v	1 + 1·00 a_u
" × ⅝	19·92	5·860	2·07	3·54	0·98	1·89	1 + 2·16 a_v	1 + 0·98 a_u
" × ½	16·15	4·751	2·00	3·54	0·98	1·92	1 + 2·09 a_v	1 + 0·96 a_u
4½ × 4½ × ¾	21·05	6·189	1·96	3·18	0·85	1·69	1 + 2·72 a_v	1 + 1·12 a_u
" × ⅝	17·80	5·236	1·90	3·18	0·87	1·70	1 + 2·51 a_v	1 + 1·10 a_u
" × ½	14·46	4·252	1·83	3·18	0·87	1·72	1 + 2·42 a_v	1 + 1·07 a_u
4 × 4 × ¾	18·49	5·437	1·78	2·83	0·76	1·48	1 + 3·10 a_v	1 + 1·28 a_u
" × ⅝	15·66	4·609	1·72	2·83	0·77	1·50	1 + 2·91 a_v	1 + 1·26 a_u
" × ½	12·75	3·750	1·66	2·83	0·77	1·52	1 + 2·80 a_v	1 + 1·22 a_u
" × ⅜	9·72	2·859	1·59	2·83	0·78	1·54	1 + 2·61 a_v	1 + 1·19 a_u
3½ × 3½ × ⅝	13·55	3·985	1·55	2·47	0·68	1·29	1 + 3·35 a_v	1 + 1·47 a_u
" × ½	11·05	3·251	1·48	2·47	0·68	1·32	1 + 3·21 a_v	1 + 1·43 a_u
" × ⅜	8·45	2·485	1·41	2·47	0·68	1·34	1 + 3·06 a_v	1 + 1·38 a_u

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables, see notes commencing page [illegible] L.

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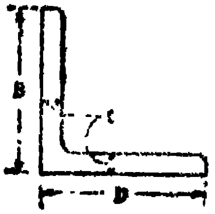


STANCHIONS (or STRUTS).

Steel Equal Angles.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B × t inches	HEIGHTS IN FEET.							
		2	3	4	5	6	7	—	—
9f Q	3 × 3 × ⅝	18·3	[illegible]	14·9	13·1	11·4	9·6	—	—
9e Q	" × ½	15·0	13·6	12·2	10·7	9·3	7·9	—	—
9d Q	" × ⅜	11·5	10·4	9·3	8·2	7·1	6·0	—	—
9c Q	" × 5/16	9·7	8·7	7·8	6·9	6·0	5·1	—	—
9b Q	" × ¼	7·8	7·1	6·4	5·7	4·9	4·2	—	—
7e Q	2½ × 2½ × ½	11·8	10·4	9·0	7·5	6·1		—	—
7d Q	" × ⅜	9·1	8·0	6·9	5·8	4·7		—	—
7c Q	" × 5/16	7·6	6·7	5·8	4·9	4·0		—	—
7b Q	" × ¼	6·2	[illegible]	[illegible]	[illegible]	3·2		—	—
6c Q	2¼ × 2¼ × 5/16	6·6	5·7	4·8	3·9			—	—
6b Q	" × ¼	5·4	4·6	3·9	3·1			—	—
5b Q	2 × 2 × ¼	4·6	3·9	3·2	2·4			—	—
5a Q	" × 3/16	3·5	3·0	2·4	1·9			—	—

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having **"both ends fixed."**

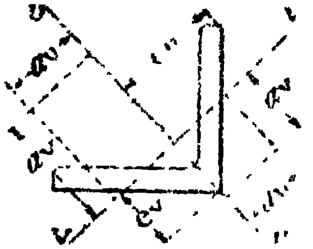
For other conditions and formulae, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

STANCHIONS (or STRUTS).

Steel Equal Angles.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Distances in inches		Radii of Gyration.		Eccentricity Coefficients.	
			a_v	a_u	Axis V—V	Axis U—U	Axis V V	Axis U—U
3 × 3 × ⅝	11·43	3·362	1·37	2·12	0·58	1·09	1 + 4·07a_v	1 + 1·76a_u
" × ½	9·36	2·753	1·31	2·12	0·58	1·12	1 + 3·89a_v	1 + 1·70a_u
" × ⅜	7·18	2·112	1·24	2·12	0·58	1·13	1 + 3·69a_v	1 + 1·64a_u
" × $\frac{5}{16}$	6·05	1·776	1·21	2·12	0·58	1·15	1 + 3·60a_v	1 + 1·61a_u
" × ¼	4·90	1·440	1·17	2·12	0·59	1·15	1 + 3·37a_v	1 + 1·60a_u
2½ × 2½ × ½	7·65	2·250	1·13	1·77	0·48	0·91	1 + 4·90a_v	1 + 2·12a_u
" × ⅜	5·89	1·734	1·06	1·77	0·48	0·93	1 + 4·62a_v	1 + 2·02a_u
" × $\frac{5}{16}$	4·96	1·460	1·03	1·77	0·48	0·94	1 + 4·49a_v	1 + 1·97a_u
" × ¼	4·04	1·187	0·99	1·77	0·48	0·95	1 + 4·32a_v	1 + 1·91a_u
2¼ × 2¼ × $\frac{5}{16}$	4·45	1·310	0·94	1·59	0·43	0·84	1 + 5·11a_v	1 + 2·22a_u
" × ¼	3·61	1·061	0·91	1·59	0·44	0·85	1 + 4·72a_v	1 + 2·20a_u
2 × 2 × ¼	3·19	0·940	0·82	1·41	0·39	0·74	1 + 5·39a_v	1 + 2·56a_u
" × $\frac{3}{16}$	2·43	0·720	0·78	1·41	0·39	0·75	1 + 5·12a_v	1 + 2·49a_u

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent over this must be allowed. see page 7

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

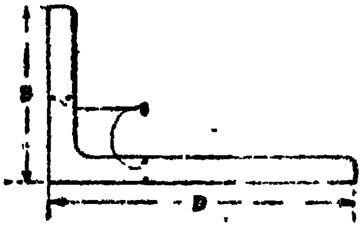
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables, see notes commencing page 192 L

REDPATH, BROWN & CO., LIMITED.



STANCHIONS (or STRUTS).

Steel Unequal Angles.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B × t inches.	HEIGHTS IN FEET.									
		2	3	4	5	6	7	8	9	10	11
25*g* R	7 × 3½ × ¾	41·5	38·5	35·5	32·5	29·5	26·5	23·5	20·4		
25*f* R	" × ⅝	35·1	32·6	30·1	27·6	25·1	22·6	20·1	17·6		
25*e* R	" × ½	28·4	26·4	24·3	22·3	20·3	18·3	16·2	14·2		
21*f* R	6 × 4 × ⅝	34·0	31·9	29·9	27·8	25·8	23·7	21·7	19·6	17·6	15·6
21*e* R	" × ½	27·5	25·9	24·2	22·5	20·9	19·2	17·6	15·9	14·3	12·6
20*f* R	6 × 3½ × ⅝	31·6	29·4	27·1	24·9	22·7	20·5	18·3	16·0	13·8	
20*e* R	" × ½	25·6	23·8	22·0	20·2	18·4	16·6	14·8	13·0	11·2	
20*d* R	" × ⅜	19·5	18·2	16·8	15·5	14·1	12·8	11·4	10·0	8·7	
63*f* R	6 × 3 × ⅝	29·0	26·5	24·0	21·5	19·0	16·5	14·0			
63*e* R	" × ½	23·5	21·5	19·5	17·5	15·4	13·4	11·4			
63*d* R	" × ⅜	18·0	16·5	14·9	13·4	11·9	10·4	8·9			

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

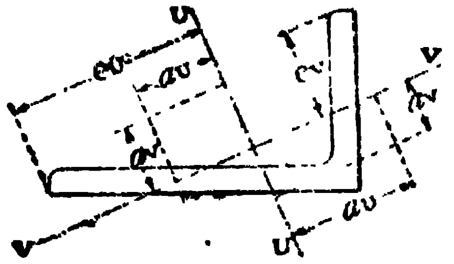
For explanations of properties, &c., see Part IV

REDPATH, BROWN & CO., LIMITED.

STANCHIONS (or STRUTS).

Steel Unequal Angles.

Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches.	Distances in inches.		Radii of Gyration.		Eccentricity Coefficients.	
			e_V	e_U	**Axis V—V**	Axis U—U	**Axis V—V**	Axis U—U
7 × 3½ × ¾	24·86	7·313	2·03	4·48	**0·73**	2·27	**1 + 3·81a_V**	1 + 0·87a_U
" × ⅝	20·98	6·172	2·05	4·51	**0·74**	2·29	**1 + 3·75a_V**	1 + 0·86a_U
" × ½	17·00	5·000	2·07	4·55	**0·74**	2·31	**1 + 3·78a_V**	1 + 0·86a_U
6 × 4 × ⅝	19·92	5·860	2·08	4·06	**0·86**	2·01	**1 + 2·82a_V**	1 + 1·00a_U
" × ½	16·15	4·750	2·08	4·09	**0·86**	2·03	**1 + 2·82a_V**	1 + 0·99a_U
6 × 3½ × ⅝	18·87	5·550	1·94	3·96	**0·74**	1·98	**1 + 3·49a_V**	1 + 1·01a_U
" × ½	15·31	4·502	1·92	3·99	**0·75**	2·00	**1 + 3·42a_V**	1 + 1·00a_U
" × ⅜	11·64	3·424	1·96	4·02	**0·76**	2·01	**1 + 3·39a_V**	1 + 1·00a_U
6 × 3 × ⅝	17·80	5·236	1·76	3·84	**0·63**	1·94	**1 + 4·43a_V**	1 + 1·02a_U
" × ½	14·46	4·252	1·76	3·88	**0·63**	1·96	**1 + 4·46a_V**	1 + 1·01a_U
" × ⅜	11·00	3·236	1·80	3·91	**0·64**	1·98	**1 + 4·38a_V**	1 + 1·00a_U

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

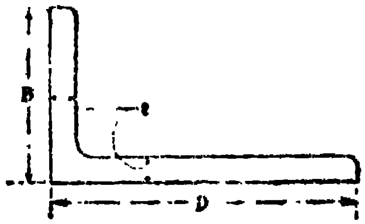
Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables see notes commencing page 192 L.



STANCHIONS (or STRUTS).

Steel Unequal Angles.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B × t inches.	HEIGHTS IN FEET.									
		2	3	4	5	6	7	8	9	10	11
17*f* R	5 × 4 × $\frac{5}{8}$	30·2	28·3	26·4	24·5	22·6	20·7	18·9	17·0	15·1	13·2
17*e* R	" × $\frac{1}{2}$	24·6	23·0	21·5	20·0	18·5	17·0	15·4	13·9	12·4	10·9
17*d* R	" × $\frac{3}{8}$	18·7	17·6	16·4	15·3	14·1	13·0	11·9	10·7	9·6	8·4
15*f* R	5 × 3 × $\frac{5}{8}$	25·6	23·4	21·3	19·1	17·0	14·8	12·6			
15*e* R	" × $\frac{1}{2}$	20·8	19·1	17·3	15·5	13·8	12·0	10·3			
15*d* R	" × $\frac{3}{8}$	15·9	14·6	13·3	11·9	10·6	9·3	8·0			
11*e* R	4 × 3 × $\frac{1}{2}$	18·0	16·4	14·9	13·3	11·8	10·2	8·7			
11*d* R	" × $\frac{3}{8}$	13·8	12·6	11·4	10·3	9·1	8·0	6·8			
7*d* R	3 × 2½ × $\frac{3}{8}$	10·2	9·1	8·0	6·9	5·8					
7*c* R	" × $\frac{5}{16}$	8·6	7·7	6·7	5·8	4·9					

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

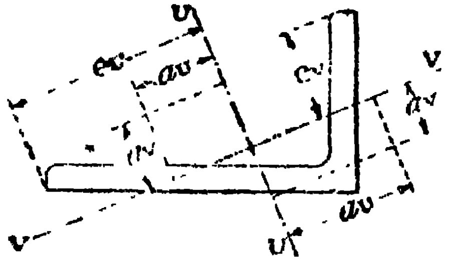
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

STANCHIONS (or STRUTS).
Steel Unequal Angles.
Dimensions and Properties.



Size, D × B × t inches.	Weight per foot in lbs.	Area in square inches	Distances in inches.		Radii of Gyration.		Eccentricity Coefficients.	
			e_v	e_u	Axis V—V	Axis U—U	Axis V—V	Axis U—U
5 × 4 × ⅝	17·80	5·236	1·81	3·46	**0·83**	1·74	**$1+2{\cdot}63a_v$**	$1+1{\cdot}15a$
„ × ½	14·46	4·252	1·83	3·48	**0·84**	1·75	**$1+2{\cdot}60a_v$**	$1+1{\cdot}13a_u$
„ × ⅜	11·00	3·236	1·82	3·49	**0·85**	1·77	**$1+2{\cdot}52a_v$**	$1+1{\cdot}12a$
5 × 3 × ⅝	15·67	4·609	1·65	3·30	**0·64**	1·64	**$1+4{\cdot}05a_v$**	$1+1{\cdot}23a$
„ × ½	12·75	3·749	1·65	3·32	**0·64**	1·66	**$1+4{\cdot}02a_v$**	$1+1{\cdot}21a$
„ × ⅜	9·72	2·859	1·67	3·36	**0·65**	1·67	**$1+3{\cdot}95a_v$**	$1+1{\cdot}20a$
4 × 3 × ½	11·05	3·251	1·45	2·75	**0·63**	1·36	**$1+3{\cdot}66a_v$**	$1+1{\cdot}48a$
„ × ⅜	8·45	2·485	1·45	2·77	**0·64**	1·38	**$1+3{\cdot}54a_v$**	$1+1{\cdot}45a$
3 × 2½ × ⅜	6·53	1·921	1·11	2·09	**0·52**	1·05	**$1+4{\cdot}10a_v$**	$1+1{\cdot}90a$
„ × 5/16	5·51	1·620	1·10	2·10	**0·52**	1·06	**$1+4{\cdot}05a_v$**	$1+1{\cdot}87a_u$

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

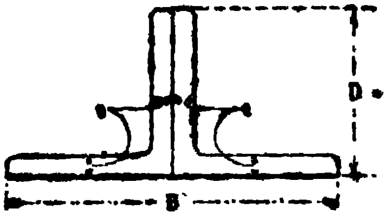
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric **value; Wc = We × K.**

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a **and** a_v **respectively.**

For full explanations of tables, see notes commencing page 192.L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	12	14	16
14*g* S	6 × 12	104	101	98·6	95·8	93·0	90·2	87·4	84·6	81·8	76·2	70·6	65·0
14*f* S	"	87·6	85·3	82·9	80·6	78·3	76·0	73·6	71·3	69·0	64·3	59·7	55·0
14*e* S	"	71·0	69·1	67·2	65·3	63·5	61·6	59·7	57·8	56·0	52·2	48·5	44·7
13*g* S	5 × 10	84·7	81·9	79·1	76·3	73·5	70·7	67·9	65·1	62·3	56·7	51·1	45·5
13*f* S	"	71·4	69·0	66·7	64·4	62·1	59·7	57·4	55·1	52·8	48·1	43·5	38·8
13*e* S	"	58·0	56·1	54·2	52·3	50·5	48·6	46·7	44·8	43·0	39·2	35·5	31·7
12*g* S	4½ × 9	75·0	72·2	69·5	66·7	63·9	61·1	58·4	55·6	52·8	47·2	41·7	*36·1*
12*f* S	"	62·9	60·6	58·3	56·0	53·7	51·4	49·1	46·8	44·4	39·8	35·2	*30·6*
12*e* S	"	51·5	49·6	47·7	45·8	44·0	42·1	40·2	38·3	36·5	32·7	29·0	*25·2*
11*g* S	4 × 8	65·3	62·5	59·7	56·9	54·2	51·4	48·6	45·9	43·1	37·6	*32·0*	
11*f* S	"	55·1	52·8	50·5	48·2	45·8	43·5	41·2	38·9	36·6	31·9	*27·3*	
11*e* S	"	45·0	43·1	41·2	39·3	37·5	35·6	33·7	31·8	30·0	26·2	*22·5*	*18·7*
11*d* S	"	34·2	32·8	31·4	30·0	28·6	27·2	25·8	24·4	23·0	20·2	*17·4*	*14·6*
10*f* S	3½ × 7	46·7	44·4	42·1	39·8	37·5	35·2	32·9	30·6	28·3	*23·7*		
10*e* S	"	38·5	36·6	34·8	32·9	31·1	29·2	27·3	25·5	23·6	*19·9*		
10*d* S	"	29·0	27·6	26·3	24·9	23·5	22·1	20·7	19·3	17·9	*15·2*	*12·4*	

Rivets ⅝-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 40D.

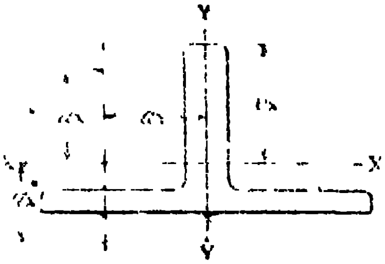
For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Dimensions and Properties.



Composed of Two Equal Angles	Weight per foot in lbs.	Area in square inches.	Distance e_X inches.	Radii of Gyration.		Eccentricity Coefficients	
				Axis Y–Y	Axis X–X	Axis Y–Y	Axis X–X
6 × 6 × ¾	59	16·88	4·24	2·53	**1·81**	1 + 0·94a_Y	**1 + 1·29a_X**
" × ⅝	49½	14·22	4·29	2·50	**1·83**	1 + 0·96a_Y	**1 + 1·28a_X**
" × ½	40½	11·50	4·34	2·48	**1·84**	1 + 0·98a_Y	**1 + 1·28a_X**
5 × 5 × ¾	48½	13·87	3·49	2·12	**1·49**	1 + 1·11a_Y	**1 + 1·56a_X**
" × ⅝	41	11·72	3·54	2·10	**1·51**	1 + 1·13a_Y	**1 + 1·55a_X**
" × ½	33½	9·50	3·58	2·08	**1·52**	1 + 1·16a_Y	**1 + 1·55a_X**
4½ × 4½ × ¾	43	12·38	3·11	1·92	**1·34**	1 + 1·21a_Y	**1 + 1·74a_X**
" × ⅝	36½	10·47	3·16	1·90	**1·35**	1 + 1·24a_Y	**1 + 1·73a_X**
" × ½	29½	8·50	3·21	1·88	**1·36**	1 + 1·28a_Y	**1 + 1·72a_X**
4 × 4 × ¾	38	10·87	2·74	1·73	**1·18**	1 + 1·34a_Y	**1 + 1·97a_X**
" × ⅝	32	9·22	2·78	1·70	**1·19**	1 + 1·38a_Y	**1 + 1·96a_X**
" × ½	26½	7·50	2·83	1·68	**1·20**	1 + 1·42a_Y	**1 + 1·95a_X**
" × ⅜	20	5·72	2·88	1·66	**1·22**	1 + 1·46a_Y	**1 + 1·93a_X**
3½ × 3½ × ⅝	28	7·97	2·41	1·50	**1·03**	1 + 1·55a_Y	**1 + 2·25a_X**
" × ½	23	6·50	2·45	1·48	**1·05**	1 + 1·60a_Y	**1 + 2·23a_X**
" × ⅜	17½	4·97	2·50	1·45	**1·06**	1 + 1·65a_Y	**1 + 2·22a_X**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

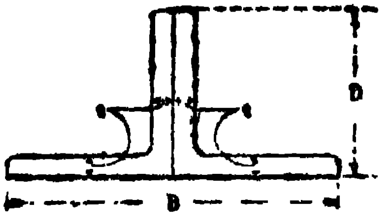
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.									
		2	3	4	5	6	7	8	9	10	12
9*f* S	3 × 6	38·9	36·6	34·3	32·0	29·6	27·3	25·0	22·7	20·4	
9*e* S	"	32·0	30·1	28·3	26·4	24·6	22·7	20·9	19·0	17·2	
9*d* S	"	24·5	23·1	21·7	20·3	18·9	17·5	16·1	14·7	13·3	*10·5*
9*c* S	"	20·4	19·2	18·1	16·9	15·8	14·6	13·5	12·3	11·2	*8·9*
9*b* S	"	16·9	15·9	15·0	14·0	13·1	12·1	11·2	10·2	9·2	*7·3*
7*e* S	2½ × 5	25·5	23·7	21·8	20·0	18·1	16·3	14·4	*12·6*		
7*d* S	"	19·3	17·9	16·5	15·2	13·8	12·4	11·0	*9·6*		
7*c* S	"	16·5	15·3	14·2	13·0	11·8	10·7	9·5	*8·4*	*7·2*	
7*b* S	"	13·1	12·1	11·2	10·3	9·4	8·5	7·5	*6·6*	*5·7*	
6*c* S	2¼ × 4½	12·3	11·3	10·3	9·3	8·3	7·4	*6·4*			
6*b* S	"	11·8	10·8	9·9	9·0	8·0	7·1	*6·2*	*5·3*		
5*b* S	2 × 4	10·4	9·4	8·4	7·5	6·5	*5·5*				
5*a* S	"	7·7	7·0	6·3	5·6	4·9	*4·2*	*3·5*			

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are, in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

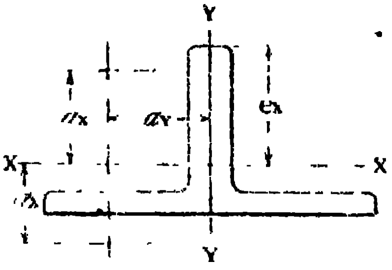
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Back to Back.

Dimensions and Properties.



Composed of Two Equal Angles	Weight per foot in lbs.	Area in square inches	Distance [illegible] in inches	Radii of Gyration Axis Y–Y	Radii of Gyration Axis X–X	Eccentricity Coefficients Axis Y–Y	Eccentricity Coefficients Axis X–X
3 × 3 × ⅝	23½	6·72	2·03	1·30	**0·87**	1 + 1·76a_Y	**1 + 2·64a_X**
" × ½	19½	5·50	2·08	1·28	**0·89**	1 + 1·82a_Y	**1 + 2·62a_X**
" × ⅜	15	4·22	2·12	1·26	**0·90**	1 + 1·89a_Y	**1 + 2·60a_X**
" × 5/16	13	3·55	2·15	1·24	**0·91**	1 + 1·93a_Y	**1 + 2·60a_X**
" × ¼	10½	2·88	2·17	1·23	**0·91**	1 + 1·97a_Y	**1 + 2·60a_X**
2½ × 2½ × ½	16	[illegible]	1·70	1·08	**0·73**	1 + 2·14a_Y	**1 + 3·18a_X**
" × ⅜	[illegible]	3·4[illegible]	1·75	1·06	**0·74**	1 + 2·24a_Y	**1 + 3·16a_X**
" × 5/16	10½	[illegible]	1·77	1·04	**0·75**	1 + 2·29a_Y	**1 + 3·15a_X**
" × ¼	8½	2·37	1·80	1·05	**0·75**	1 + 2·35a_Y	**1 + 3·15a_X**
2¼ × 2¼ × 5/16	9½	2·26	1·58	0·94	**0·67**	1 + 2·51a_Y	**1 + 3·51a_X**
" × ¼	7½	2·12	1·61	0·95	**0·68**	1 + 2·58a_Y	**1 + 3·49a_X**
2 × 2 × ¼	7	1·88	1·42	0·83	**0·59**	1 + 2·88a_Y	**1 + 3·97a_X**
" × 5/16	5½	1·44	1·45	0·81	**0·60**	1 + 3·00a_Y	**1 + 4·01a_X**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

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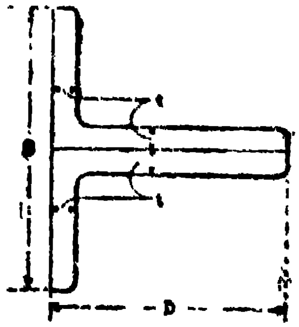


COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Safe Concentric Loads, in Tons. Ends Fixed.

Reference Mark.	Size, D × B inches	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	12	14	16
25*g* T	7 × 7	87·3	84·4	80·2	77·4	73·9	70·3	66·8	63·3	59·8	52·7	45·7	38·7
25*f* T	"	74·1	71·1	68·0	65·0	62·0	58·9	55·9	52·9	49·8	43·8	37·7	31·7
25*e* T	"	59·9	57·4	54·9	52·4	49·9	47·4	44·9	42·4	39·9	34·9	29·9	
21*f* T	6 × 8	71·5	69·2	66·9	64·5	62·2	59·9	57·6	55·3	52·9	48·3	43·7	39·0
21*e* T	"	57·9	56·0	54·1	52·2	50·3	48·4	46·4	44·5	42·6	38·8	35·0	31·2
20*f* T	6 × 7	66·9	64·2	61·7	59·1	56·5	53·9	51·3	48·7	46·1	41·0	35·9	30·8
20*e* T	"	54·2	52·1	49·9	47·8	45·7	43·5	41·4	39·3	37·1	32·8	28·6	24·3
20*d* T	"	41·2	39·5	37·8	36·2	34·5	32·9	31·2	29·6	27·9	24·6	21·3	18·0
63*f* T	6 × 6	62·1	59·2	56·2	53·3	50·3	47·3	44·4	41·4	38·5	32·6	26·6	
63*e* T	"	50·3	47·9	45·4	42·9	40·5	38·0	35·6	33·1	30·7	25·7		
63*d* T	"	38·2	36·3	34·4	32·5	30·6	28·7	26·8	24·8	22·9	19·1		

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

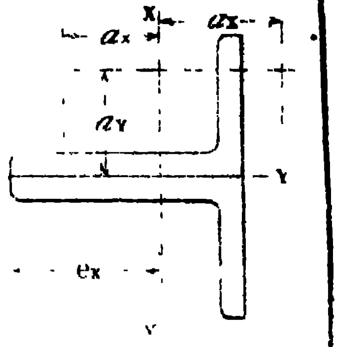
REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Dimensions and Properties.



Composed of Two Unequal Angles.	Weight per foot in lbs.	Area in square inches	Distance e_X inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
7 × 3½ × ¾	51	14·62	4·40	**1·24**	2·21	**1 + 2·26a_Y**	1 + 0·90a_X
" × ⅝	43½	12·34	4·45	**1·22**	2·22	**1 + 2·35a_Y**	1 + 0·90a_X
" × ½	35½	10·00	4·50	**1·20**	2·24	**1 + 2·44a_Y**	1 + 0·90a_X
6 × 4 × ⅝	41	11·72	3·98	**1·51**	1·88	**1 + 1·74a_Y**	1 + 1·12a_X
" × ½	[illegible]	9·50	4·03	**1·49**	1·90	**1 + 1·80a_Y**	1 + 1·12a_X
6 × 3½ × ⅝	39	11·09	3·89	**1·28**	1·89	**1 + 2·12a_Y**	1 + 1·09a_X
" × ½	32	9·00	3·94	**1·26**	1·91	**1 + 2·20a_Y**	1 + 1·08a_X
" × ⅜	24½	6·84	3·99	**1·24**	1·91	**1 + 2·28a_Y**	1 + 1·09a_X
6 × 3 × ⅝	37	10·47	3·78	**1·06**	1·89	**1 + 2·66a_Y**	1 + 1·06a_X
" × ½	30½	8·50	3·83	**1·04**	1·91	**1 + 2·78a_Y**	1 + 1·05a_X
" × ⅜	23½	6·47	3·88	**1·01**	1·92	**1 + 2·91a_Y**	1 + 1·05a_X

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

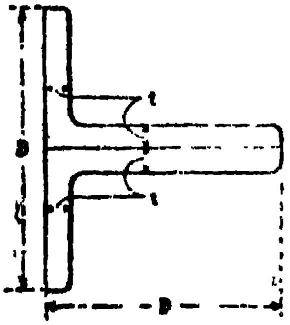
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	12	14	16
17*f* T	5 × 8	63·9	61·9	59·9	57·8	55·8	53·8	51·7	49·7	47·6	43·6	39·5	35·4
17*c* T	"	51·9	50·3	48·7	47·0	45·4	43·7	42·1	40·5	38·8	35·5	32·3	29·0
17*d* T	"	39·6	38·3	37·1	35·8	34·6	33·3	32·1	30·8	29·6	27·1	24·6	22·1
15*f* T	5 × 6	55·0	52·5	50·1	47·6	45·2	42·7	40·3	37·8	35·4	30·5	25·5	
15*e* T	"	44·6	42·6	40·6	38·5	36·5	34·4	32·4	30·4	28·3	24·2	20·2	
15*d* T	"	33·9	32·4	3[illegible]·8	29·[illegible]	27·6	26·0	24·4	22·9	21·3	18·1	14·9	
11*e* T	4 × 6	38·9	37·3	35·6	34·0	32·3	30·7	29·0	27·4	25·7	22·4	*19·1*	
11*d* T	"	29·7	28·4	27·1	25·8	24·6	23·3	22·0	20·7	19·4	16·8	*14·3*	
7*d* T	3 × 5	22·4	21·2	19·9	18·6	17·4	16·1	14·9	13·6	12·4	*9·9*		
7*c* T	"	18·9	17·9	16·8	15·8	14·7	13·7	12·6	11·6	10·5	*8·4*		

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

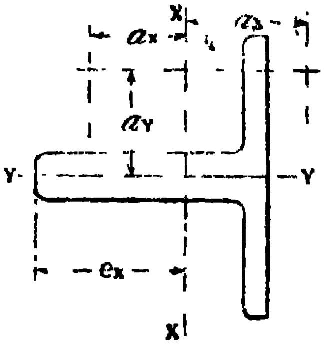
REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Short Legs Outstanding.

Dimensions and Properties.



Composed of Two Unequal Angles.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
5 × 4 × $\frac{5}{8}$	37	10·47	3·39	1·60	**1·54**	1 + 1·56a_Y	**1 + 1·43a_X**
" × $\frac{1}{2}$	30½	8·50	3·44	1·58	**1·55**	1 + 1·61a_Y	**1 + 1·43a_X**
" × $\frac{3}{8}$	23½	6·47	3·49	**1·55**	1·57	**1 + 1·65a_Y**	1 + 1·42a_X
5 × 3 × $\frac{5}{8}$	32½	9·22	3·22	**1·13**	1·56	**1 + 2·36a_Y**	1 + 1·32a_X
" × $\frac{1}{2}$	27	7·50	3·26	**1·10**	1·58	**1 + 2·46a_Y**	1 + 1·31a_X
" × $\frac{3}{8}$	21	5·72	3·32	**1·08**	1·59	**1 + 2·57a_Y**	1 + 1·31a_X
4 × 3 × $\frac{1}{2}$	23	6·50	2·68	**1·18**	1·24	**1 + 2·14a_Y**	1 + 1·75a_X
" × $\frac{3}{8}$	17½	4·97	2·73	**1·16**	1·25	**1 + 2·23a_Y**	1 + 1·75a_X
3 × 2½ × $\frac{3}{8}$	14	3·84	2·05	1·00	**0·92**	1 + 2·47a_Y	**1 + 2·43a_X**
" × $\frac{5}{16}$	12	3·24	2·08	0·99	**0·92**	1 + 2·53a_Y	**1 + 2·37a_X**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

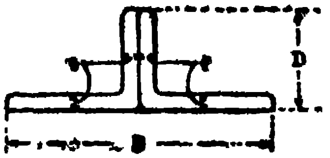
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	11	12	14
25*g* U	3½ × 14	85·3	80·4	75·5	70·7	65·8	60·9	56·1	51·2	46·4	41·5	*36·6*	
25*f* U	"	72·1	68·0	63·9	59·8	55·8	51·8	47·7	43·7	39·6	35·5	*31·5*	
25*e* U	"	58·5	55·2	52·0	48·7	45·5	42·3	39·0	35·8	32·5	29·2	*26·0*	
21*f* U	4 × 12	69·9	66·7	63·6	60·5	57·3	54·2	51·0	47·9	44·8	41·6	38·5	*32·2*
21*e* U	"	56·7	54·2	51·7	49·1	46·6	44·1	41·6	39·1	36·6	34·0	31·5	*26·5*
20*f* U	3½ × 12	65·1	61·5	58·0	54·5	51·0	47·5	43·9	40·4	36·9	33·4	*29·9*	
20*e* U	"	52·9	50·0	47·2	44·4	41·6	38·8	35·9	33·1	30·3	27·5	*24·7*	
20*d* U	"	40·2	38·1	36·0	33·9	31·7	29·6	27·5	25·4	23·3	21·1	*19·0*	
63*f* U	3 × 12	59·9	55·8	51·8	47·7	43·6	39·6	35·5	31·4	27·4			
63*e* U	"	48·7	45·5	42·2	39·0	35·7	32·5	29·2	26·0	22·7			
63*d* U	"	37·2	34·7	32·3	29·9	27·4	25·0	22·5	20·1	17·6			

Rivets ¾-in. diam. at 6-in. pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

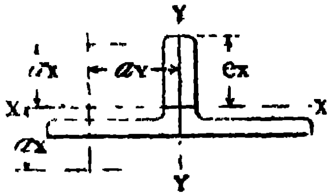
Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).



Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Dimensions and Properties.

Composed of Two Unequal Angles.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y—Y	Axis X—X	Axis Y—Y	Axis X—X
7 × 3½ × ¾	50½	14·62	2·64	3·41	**0·90**	1 + 0·60a_Y	**1 + 3·24a_X**
" × ⅝	43	12·34	2·69	3·38	**0·91**	1 + 0·61a_Y	**1 + 3·22a_X**
" × ½	35	10·00	2·74	3·35	**0·92**	1 + 0·62a_Y	**1 + 3·20a_X**
6 × 4 × ⅝	40½	11·72	2·98	2·76	**1·12**	1 + 0·79a_Y	**1 + 2·87a_X**
" × ½	33	9·50	3·03	2·73	**1·13**	1 + 0·81a_Y	**1 + 2·86a_X**
6 × 3½ × ⅝	38½	11·10	2·63	2·83	**0·94**	1 + 0·75a_Y	**1 + 2·93a_X**
" × ½	31½	9·00	2·68	2·81	**0·96**	1 + 0·76a_Y	**1 + 2·91a_X**
" × ⅜	24	6·85	2·73	2·77	**0·97**	1 + 0·78a_Y	**1 + 2·90a_X**
6 × 3 × ⅝	36½	10·47	2·27	2·92	**0·77**	1 + 0·71a_Y	**1 + 3·80a_X**
" × ½	29½	8·50	2·32	2·89	**0·78**	1 + 0·72a_Y	**1 + 3·76a_X**
" × ⅜	23	6·47	2·37	2·86	**0·79**	1 + 0·73a_Y	**1 + 3·74a_X**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

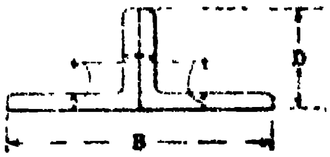
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_Y and a_X respectively.

For full explanations of tables, see notes commencing page 192L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	11	12	14
17*f* U	4 × 10	62·6	59·9	57·2	54·4	51·7	49·0	46·3	43·6	40·9	38·1	35·4	*30·0*
17*e* U	"	50·9	48·7	46·5	44·3	42·2	40·0	37·8	35·6	33·4	31·3	29·1	*24·7*
17*d* U	"	38·8	37·1	35·5	33·9	32·2	30·6	28·9	27·3	25·6	24·0	22·3	*19·0*
15*f* U	3 × 10	53·0	49·6	46·2	42·7	39·3	35·9	32·5	29·0	25·6			
15*e* U	"	43·2	40·5	37·7	34·9	32·2	29·5	26·7	23·9	21·2			
15*d* U	"	33·[illegible]	30·9	28·9	26·8	24·7	22·7	20·6	18·5	16·5	*14·4*		
11*e* U	3 × 8	37·6	35·4	33·1	30·8	28·5	26·2	23·9	21·7	19·4	*17·1*		
11*d* U	"	28·8	27·1	25·4	23·7	21·9	20·2	18·5	16·8	15·1	*13·4*		
7*d* U	2½ × 6	21·7	20·2	18·6	17·0	15·4	13·8	12·2	*10·7*				
7*c* U	"	18·4	17·0	15·7	14·4	13·1	11·7	10·4	*9·1*				

Rivets ¾-in. diam. at 6-in.-pitch.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 40D.

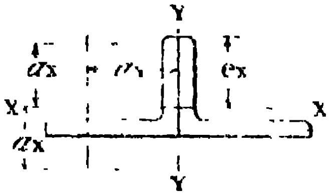
For explanations of properties, &c., see Part IV.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Unequal Angles Back to Back.

Long Legs Outstanding.

Dimensions and Properties.



Composed of Two Unequal Angles.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y–Y	Axis X–X	Axis Y–Y	Axis X–X
5 × 4 × ⅝	36½	10·47	2·89	2·22	**1·15**	1 + 1·01a_y	**1 + 2·16a_x**
" × ½	29½	8·50	2·94	2·20	**1·17**	1 + 1·03a_y	**1 + 2·15a_x**
" × ⅜	23	6·47	2·99	2·18	**1·18**	1 + 1·06a_y	**1 + 2·14a_x**
5 × 3 × ⅝	32	9·22	2·21	2·37	**0·80**	1 + 0·89a_y	**1 + 3·40a_x**
" × ½	26½	7·50	2·26	2·34	**0·82**	1 + 0·91a_y	**1 + 2·99a_x**
" × ⅜	20	5·72	2·31	2·31	**0·83**	1 + 0·93a_y	**1 + 2·97a_x**
4 × 3 × ½	23	6·50	2·18	1·80	**0·85**	1 + 1·23a_y	**1 + 3·41a_x**
" × ⅜	17½	4·97	2·23	1·78	**0·86**	1 + 1·26a_y	**1 + 3·40a_x**
3 × 2½ × ⅜	14	3·84	1·80	1·32	**0·72**	1 + 1·73a_y	**1 + 3·37a_x**
" × 5/16	12	3·24	1·83	1·30	**0·73**	1 + 1·76a_y	**1 + 3·35a_x**

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

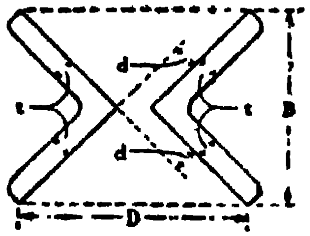
Each weight per foot is for the riveted shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load ; K = relative eccentricity coefficients ; Wc = equivalent concentric value ; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192 L.

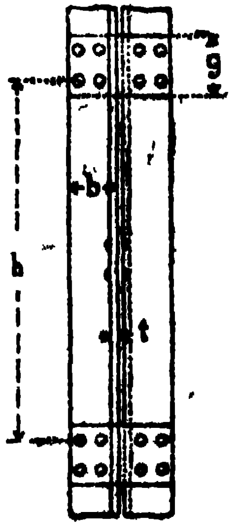


COMPOUND STANCHIONS (or STRUTS).

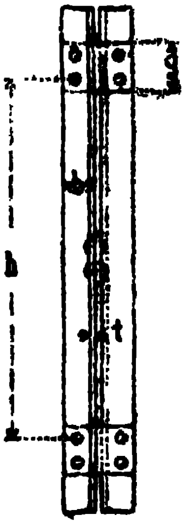
Two Steel Equal Angles Battened.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	12	14	16
14*g* V	10⅝ × 8½	105	103	100	98·6	96·4	94·2	91·9	89·7	87·5	83·1	78·6	74·2
14*f* V	10 × ″	88·7	86·9	85·0	83·1	81·3	79·4	77·6	75·7	73·9	70·2	66·5	62·7
14*e* V	9 11/16 × ″	71·8	70·3	68·8	67·3	65·8	64·3	62·9	61·4	59·9	56·9	53·9	51·0
13*g* V	9 × 7⅛	85·7	83·5	81·3	79·1	76·9	74·7	72·5	70·3	68·1	63·6	59·2	54·8
13*f* V	8⅝ × ″	72·4	70·6	68·7	66·9	65·0	63·2	61·3	59·5	57·6	53·9	50·2	46·5
13*e* V	8¼ × ″	58·7	57·3	55·8	54·3	52·8	51·3	49·8	48·3	46·9	43·9	40·9	37·9
12*g* V	8 5/16 × 6⅜	76·0	73·8	71·6	69·4	67·2	65·0	62·8	60·6	58·4	54·0	49·6	45·2
12*f* V	7 13/16 × ″	64·3	62·5	60·6	58·8	56·9	55·1	53·3	51·4	49·6	45·9	42·2	38·5
12*e* V	7 5/16 × ″	52·3	50·8	49·3	47·8	46·3	44·9	43·4	41·9	40·4	37·4	34·5	31·5



For 6-in. and 5-in. angles.



For 4½-in. to 2-in. angles.

The angles forming stanchions or struts of this class are usually secured together with batten plates spaced alternately at right angles to each other.

See opposite page for conventional spacing and proportions.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are, in accordance with the working stresses prescribed by the London County Council General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

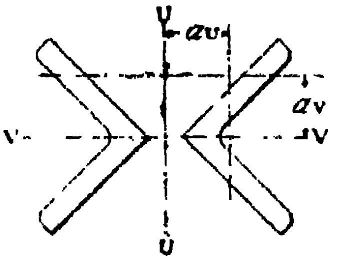
For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Battened.

Dimensions and Properties.



Composed of Two Equal Angles.	Weight per foot in lbs.	Area in square inches.	Thickness of Batten Plates. Inch.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis V—V	Axis U—U	Axis V—V	Axis U—U
6 × 6 × ¾	57½	16·88	¾	**2·28**	3·23	**1 + 0·82a_v**	1 + 0·50a_u
" × ⅝	48½	14·22	⅝	**2·30**	3·09	**1 + 0·81a_v**	1 + 0·52a_u
" × ½	39½	11·50	½	**2·32**	2·95	**1 + 0·79a_v**	1 + 0·55a_u
5 × 5 × ¾	47½	13·87	⅝	**1·88**	2·83	1 + 1·00a_v	**1 + 0·56a_u**
" × ⅝	40	11·72	9/16	**1·89**	2·69	1 + 0·98a_v	**1 + 0·59a_u**
" × ½	32½	9·50	½	**1·92**	2·55	1 + 0·96a_v	**1 + 0·63a_u**
4½ × 4½ × ¾	42½	12·38	⅝	**1·69**	2·63	1 + 1·12a_v	**1 + 0·60a_u**
" × ⅝	36	10·47	7/16	**1·70**	2·49	1 + 1·10a_v	**1 + 0·64a_u**
" × ½	29	8·50	7/16	**1·72**	2·35	1 + 1·07a_v	**1 + 0·69a_u**

CONVENTIONAL MAXIMUM SPACING AND MINIMUM PROPORTIONS OF BATTEN PLATES FOR CONCENTRIC LOADING (*Am. Ry. Engineering and Maintenance of Way Assoc.*)

Maximum centres of end rivets of batten plates = *h* inches.

h = the lesser value of $\left\{\begin{array}{l}\text{10 times } b \text{ the width of one leg in inches.}\\ \text{60 times } t \text{ the angle thickness in inches.}\end{array}\right.$

Minimum width of batten plates = *g* inches.

g = the greater value of $\left\{\begin{array}{l}b \text{ the width of one leg, or } c \text{ the horizontal centres of rivets, or the}\\ \text{least width suitable for 2 rivets, in inches.}\end{array}\right.$

Rivet diameter = ⅞ inch for angles ¾, ⅝, ½, and ⅜ inch thick.

" " = ¾ " " " 7/16 inch thick.

" " = ⅝ " " " ½ and 7/16 inch thick.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. ov. this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of batten plates, rivets, base, &c., to be added.

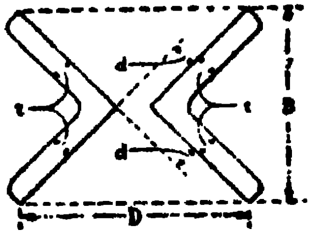
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We=actual eccentric load; K=relative eccentricity coefficient; Wc=equivalent concentric value, Wc=We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables, see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Battened.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D × B inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	11	12	14
11*g* V	7⅝ × 5 11/16	66·2	64·0	61·9	59·7	57·5	55·3	53·1	50·9	48 7	46·5	44·3	39·9
11*f* V	7¼ × "	56·2	54·3	52·5	50·7	48·8	47·0	45·1	43·3	41·5	39·6	37·8	34·1
11*e* V	6⅞ × "	45·7	44·3	42·8	41·3	39·8	38·4	36·9	35·4	33·9	32·4	31·0	28·0
11*d* V	6 9/16 × "	34·9	33·8	32·7	31·5	30·4	29·3	28·2	27·1	26·0	24·9	23·8	21·5
10*f* V	6 9/16 × 5	48·1	46·2	44·4	42·5	40·7	38·9	37·0	35·2	33·3	31·5	29·6	25·9
10*e* V	6 3/16 × "	39·3	37·8	36·3	34·8	33·3	31·8	30·4	28·9	27·4	25·9	24·4	21·5
10*d* V	5⅞ × "	30·0	28·9	27·8	26·7	25·6	24·5	23·3	22·2	21·1	20·0	18·9	16·7
9*f* V	5⅞ × 4½	40·0	38·1	36·3	34·5	32·6	30·8	28·9	27·1	25·3	23·4	21·6	17·9
9*e* V	5½ × "	32·8	31·3	29·8	28·4	26·9	25·4	23·9	22·4	21·0	19·5	18·0	15·1
9*d* V	5 3/16 × "	25·2	24·1	22·9	21·8	20·7	19·6	18·5	17·4	16·3	15·1	14·0	11·8
9*c* V	5 1/16 × "	21·2	20·3	19·3	18·4	17·5	16·5	15·6	14·7	13·8	12·8	11·9	10·0
9*b* V	4 13/16 × "	17·2	16·4	15·7	14·9	14·2	13·4	12·7	11·9	11·2	10·4	9·7	8·2
7*e* V	4 13/16 × 3 9/16	26·2	24 8	23·3	21·8	20·3	18·9	17 4	15·9	14·4	13·0	*11·5*	
7*d* V	4 7/16 × "	20·3	19·2	18·0	16 9	15·8	14·7	13·6	12·5	11·4	10·3	*9·2*	
7*c* V	4⅜ × "	17·1	16·2	15·2	14·3	13·4	12·5	11·5	10·6	9·7	8·8	*7·8*	
7*b* V	4⅛ × "	13·9	13·1	12·4	11·7	10·9	10·2	9·4	8·7	7·9	7·2	*6·4*	
6*c* V	4 1/16 × 3 3/16	15·1	14·2	13·3	12·3	11·4	10·5	9·6	8·6	7·7	*6·8*		
6*b* V	3¾ × "	12·3	11·5	10·8	10·0	9·3	8·5	7·8	7·0	6·3	*5·5*		
5*b* V	3 7/16 × 2⅞	10·7	9·9	9·1	8·4	7·6	6·9	6·1	5·3				
5*a* V	3 5/16 × "	8·2	7·6	7·0	6·4	5·9	5·3	4·7	4·2	*3·6*			

For sketch, see page 180 L.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 40B.

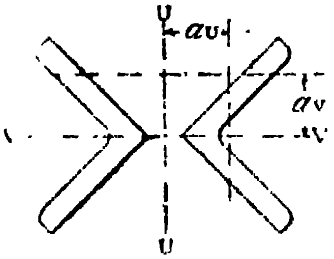
For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

COMPOUND STANCHIONS (or STRUTS).

Two Steel Equal Angles Battened.

Dimensions and Properties.



Composed of Two Equal Angles.	Weight per foot in lbs.	Area in square inches.	Thickness of Batten Plate. Inch.	Radii of Gyration. Axis V—V	Radii of Gyration. Axis U—U	Eccentricity Coefficients. Axis V—V	Eccentricity Coefficients. Axis U—U
4 × 4 × ¾	37	10·87	¾	**1·48**	2·44	**$1+1{\cdot}28a_v$**	$1+0{\cdot}64a_u$
" × ⅝	31½	9·22	⅝	**1·50**	2·29	**$1+1{\cdot}26a_v$**	$1+0{\cdot}69a_u$
" × ½	25½	7·50	½	**1·52**	2·15	**$1+1{\cdot}22a_v$**	$1+0{\cdot}74a_u$
" × ⅜	19½	5·72	⅜	**1·54**	2·01	**$1+1{\cdot}19a_v$**	$1+0{\cdot}81a_u$
3½ × 3½ × ⅝	27½	7·97	⅝	**1·29**	2·10	**$1+1{\cdot}47a_v$**	$1+0{\cdot}74a_u$
" × ½	22½	6·50	½	**1·31**	1·95	**$1+1{\cdot}43a_v$**	$1+0{\cdot}81a_u$
" × ⅜	17	4·97	⅜	**1·34**	1·81	**$1+1{\cdot}38a_v$**	$1+0{\cdot}89a_u$
3 × 3 × ⅝	23	6·72	⅝	**1·09**	1·90	**$1+1{\cdot}76a_v$**	$1+0{\cdot}81a_u$
" × ½	19	5·50	½	**1·12**	1·76	**$1+1{\cdot}70a_v$**	$1+0{\cdot}89a_u$
" × ⅜	14½	4·22	⅜	**1·13**	1·61	**$1+1{\cdot}64a_v$**	$1+0{\cdot}99a_u$
" × 5/16	12½	3·55	⅜	**1·15**	1·58	**$1+1{\cdot}61a_v$**	$1+1{\cdot}01a_u$
" × ¼	10	2·88	¼	**1·15**	1·47	**$1+1{\cdot}60a_v$**	$1+1{\cdot}11a_u$
2½ × 2½ × ½	15½	4·50	½	**0·91**	1·56	**$1+2{\cdot}12a_v$**	$1+0{\cdot}99a_u$
" × ⅜	12	3·47	⅜	**0·93**	1·41	**$1+2{\cdot}02a_v$**	$1+1{\cdot}11a_u$
" × 5/16	10	2·92	⅜	**0·94**	1·38	**$1+1{\cdot}97a_v$**	$1+1{\cdot}14a_u$
" × ¼	8½	2·37	¼	**0·95**	1·26	**$1+1{\cdot}94a_v$**	$1+1{\cdot}28a_u$
2¼ × 2¼ × 5/16	9	2·26	⅜	**0·84**	1·28	**$1+2{\cdot}22a_v$**	$1+1{\cdot}22a_u$
" × ¼	7½	2·12	¼	**0·85**	1·17	**$1+2{\cdot}20a_v$**	$1+1{\cdot}37a_u$
2 × 2 × ¼	6½	1·88	¼	**0·74**	1·07	**$1+2{\cdot}56a_v$**	$1+1{\cdot}48a_u$
" × 3/16	5	1·44	¼	**0·75**	1·03	**$1+2{\cdot}49a_v$**	$1+1{\cdot}54a_u$

For conventional spacing and proportions, see page 181 L.

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of batten plates, rivets, base, &c., to be added.

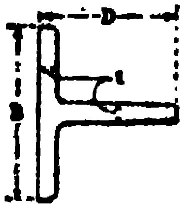
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

W_e=actual eccentric load; K=relative eccentricity coefficient; W_c=equivalent concentric value; $W_c = W_e \times K$.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_v and a_u respectively.

For full explanations of tables see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



STANCHIONS (or STRUTS).
Steel Tees.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, B × D × t inches.	HEIGHTS IN FEET.											
		2	3	4	5	6	7	8	9	10	11	12	14
21*e* W	6 × 4 × ½	28·4	27·2	25·9	24·6	23·4	22·1	20·8	19·5	18·3	17·0	15·7	*13·2*
20*e* W	6 × 3 × ½	21·5	22·8	21·2	19·6	17·9	16·3	14·7	13·0	11·4			
20*d* W	" × ⅜	18·7	17·5	16·2	15·0	13·8	12·5	11·3	10·1	8·8			
19*e* W	5 × 4 × ½	25·3	24·2	23·0	21·8	20·6	19·4	18·3	17·1	15·9	14·7	13·5	*11·2*
19*d* W	" × ⅜	19·3	18·4	17·5	16·5	15·6	14·7	13·8	12·9	11·9	11·0	10·1	*8·3*
17*e* W	5 × 3 × ½	21·6	20·3	18·9	17·5	16·1	14·7	13·4	12·0	10·6			
17*d* W	" × ⅜	16·6	15·5	14·5	13·4	12·4	11·3	10·3	9·3	8·2	*7·2*		
16*e* W	4 × 5 × ½	24·4	22·7	21·1	19·4	17·8	16·2	14·5	12·9	11·2			
16*d* W	" × ⅜	18·5	17·2	16·0	14·7	13·4	12·1	10·8	9·6	8·3			

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are, in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

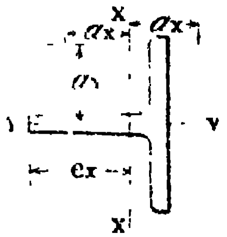
Safe loads printed in italics are for heights greater than 40D.

For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

STANCHIONS (or STRUTS).
Steel Tees.

Dimensions and Properties.



Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration.		Eccentricity Coefficients.	
				Axis Y Y	Axis X X	Axis Y - Y	Axis X—X
6 × 4 × $\frac{1}{2}$	16·22	4·771	3·03	1·34	**1·13**	1 + 1·66a_y	**1 + 2·39a_x**
6 × 3 × $\frac{1}{2}$	14·53	4·272	2·32	1·42	**0·78**	1 + 1·48a_y	**1 + 3·76a_x**
" × $\frac{3}{8}$	11·08	3·260	2·37	1·40	**0·79**	1 + 1·53a_y	**1 + 3·75a_x**
5 × 4 × $\frac{1}{2}$	14·51	4·268	2·95	**1·08**	1·16	**1 + 2·13a_y**	1 + 2·18a_x
" × $\frac{3}{8}$	11·07	3·257	3·00	**1·06**	1·17	**1 + 2·21a_y**	1 + 2·19a_x
5 × 3 × $\frac{1}{2}$	12·79	3·762	2·26	1·15	**0·82**	1 + 1·87a_y	**1 + 3·37a_x**
" × $\frac{3}{8}$	9·78	2·875	2·31	1·13	**0·83**	1 + 1·94a_y	**1 + 3·37a_x**
4 × 5 × $\frac{1}{2}$	14·50	4·264	3·47	**0·78**	1·56	**1 + 3·31a_y**	1 + 1·43a_x
" × $\frac{3}{8}$	11·06	3·253	3·53	**0·76**	1·54	**1 + 3·45a_y**	1 + 1·48a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

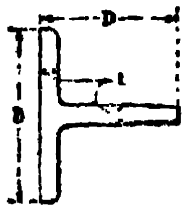
Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192 L.

REDPATH, BROWN & CO., LIMITED.



STANCHIONS (or STRUTS).

Steel Tees.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, B × D × t inches	HEIGHTS IN FEET.									
		2	3	4	5	6	7	8	9	10	11
15*e* W	4 × 4 × ½	21·7	20·3	19·0	17·6	16·2	14·9	13·5	12·2	10·8	9·4
15*d* W	„ × ⅜	16·5	15·4	14·4	13·3	12·3	11·2	10·1	9·1	8·0	
14*c* W	4 × 3 × ½	18·8	17·7	16·6	15·4	14·3	13·1	12·0	10·8	9·7	*8·5*
14*d* W	„ × ⅜	14·5	13·6	12·7	11·8	11·0	10·1	9·2	8·4	7·5	*6·6*
13*e* W	3½ × 3½ × ½	18·5	17·1	15·8	14·5	13·1	11·8	10·5	9·1		
13*d* W	„ × ⅜	14·1	13·0	12·0	11·0	9·9	8·9	7·8	6·8		
11*e* W	3 × 3 × ½	15·3	14·0	12·7	11·4	10·1	8·8	7·5			
11*d* W	„ × ⅜	11·7	10·7	9·6	8·6	7·6	6·6	5·5			
8*d* W	2½ × 2½ × ⅜	9·3	8·3	7·3	6·3	5·3					
8*b* W	„ × ¼	6·3	5·6	4·9	4·2	3·5					

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

Safe loads printed in italics are for heights greater than 40D.

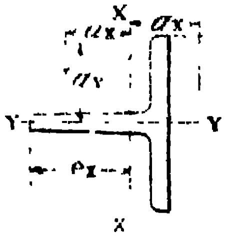
For explanations of properties, &c., see Part IV.

REDPATH, BROWN & CO., LIMITED.

STANCHIONS (or STRUTS).

Steel Tees.

Dimensions and Properties.



Size, B × D × t inches.	Weight per foot in lbs.	Area in square inches.	Distance e_x inches.	Radii of Gyration		Eccentricity Coefficients.	
				Axis Y—Y	Axis X - X	Axis Y – Y	Axis X - X
4 × 4 × ½	12·78	3·758	2·84	**0·83**	1·20	**1 + 2·90a_y**	1 + 1·98a_x
" × ⅜	9·77	2·872	2·89	**0·81**	1·21	**1 + 3·02a_y**	1 × 1·98a_x
4 × 3 × ½	11·08	3·260	2·18	0·89	**0·85**	1 + 2·51a_y	**1 + 3·01a_x**
" × ⅜	8·49	2·498	2·23	0·87	**0·86**	1 + 2·61a_y	**1 + 3·00a_x**
3½ × 3½ × ½	11·08	3·258	2·46	**0·73**	1·04	**1 + 3·26a_y**	1 + 2·27a_x
" × ⅜	8·49	2·496	2·51	**0·71**	1·05	**1 + 3·41a_y**	1 + 2·27a_x
3 × 3 × ½	9·38	2·760	2·08	**0·63**	0·88	**1 + 3·71a_y**	1 + 2·65a_x
" × ⅜	7·21	2·121	2·13	**0·62**	0·89	**1 + 3·90a_y**	1 + 2·65a_x
2½ × 2½ × ⅜	5·92	1·741	1·75	**0·52**	0·74	**1 + 4·61a_y**	1 + 3·17a_x
" × ¼	4·07	1·197	1·80	**0·50**	0·75	**1 + 4·96a_y**	1 + 3·19a_x

In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7

Each weight per foot is for the shaft only. Weight of connections, &c., to be added.

Least radii of gyration and relative eccentricity coefficients are printed in prominent type.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for a_y and a_x respectively.

For full explanations of tables, see notes commencing page 192 L.

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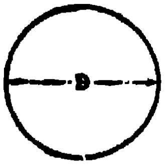
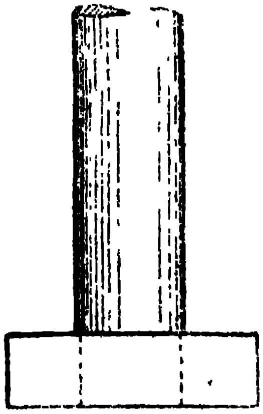


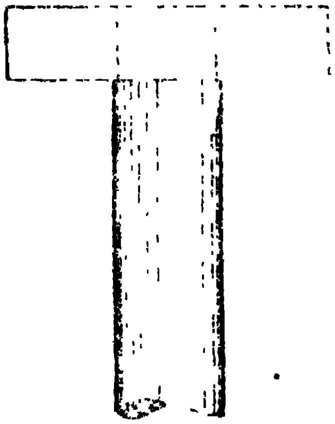
STANCHIONS (or COLUMNS).
Solid Round Steel.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D inches.	HEIGHTS IN FEET.												
		6	8	10	12	14	16	18	20	22	24	26	28	30
23 X	12	667	644	622	599	576	554	531	508	486	463	441	418	395
22 X	11½	610	588	566	545	523	501	480	458	436	415	393	371	349
21 X	11	555	534	511	493	472	451	431	410	389	368	348	327	306
20 X	10½	503	483	463	444	424	404	384	364	345	325	305	285	265
19 X	10	453	435	416	397	378	359	340	322	303	284	265	246	227
18 X	9½	407	389	371	353	335	317	299	281	263	245	227	210	192
17 X	9	362	345	328	311	294	277	260	243	226	209	192	176	159
16 X	8½	320	304	288	272	256	240	224	208	192	176	160	144	
15 X	8	281	266	251	236	221	206	191	175	160	145	130		
14 X	7½	244	230	216	202	188	174	159	145	131	117			



BASE.



CAP.

Bases and Caps are formed of heavy steel slabs, bored out and shrunk on to the accurately machined column ends.

The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel, having "both ends fixed."

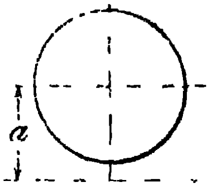
For other conditions and formulæ, see notes commencing page 192 L.

For explanations of properties, &c., see Part IV.

STANCHIONS (or COLUMNS).

Solid Round Steel.

Dimensions and Properties.



Diameter in inches.	Weight per foot in lbs.	Area in square inches.	Radius of Gyration.	Eccentricity Coefficients.	
				For Semi-diameter.	General.
12	384·6	113·100	3·000	5	$1+0·67a$
11½	353·2	103·870	2·875	5	$1+0·70a$
11	323·2	95·033	2·750	5	$1+0·73a$
10½	294·5	86·590	2·625	5	$1+0·76a$
10	267·1	78·540	2·500	5	$1+0·80a$
9½	241·0	70·882	2·375	5	$1+0·84a$
9	216·3	63·617	2·250	5	$1+0·89a$
8½	193·0	56·745	2·125	5	$1+0·94a$
8	170·9	50·265	2·000	5	$1+1·00a$
7½	150·3	44·179	1·875	5	$1+1·07a$

SLABS OF THE UNDERNOTED WIDTHS AND THICKNESSES ARE STOCKED IN LENGTHS OF ABOUT 12 FEET.

Width and Thickness. Inches.	Suitable for Diameters.	Width and Thickness. Inches.	Suitable for Diameters.
18 × 4	10 to 8 inches	10 × 2	6 to 4 inches.
16 × 3½	8 to 7 "	9 × 1¾	4 to 3½ "
14 × 3	7 to 6 "	8 × 1½	3½ to 2½ "
12 × 2½	6 to 5 "	—	—

Above sizes are for concentric loading.

Special calculations are necessary for the design of slab cap plates supporting eccentric loads. See Part IV.

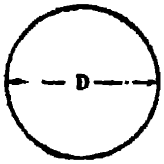
In each case the weight per foot given is the minimum that can be rolled, and a rolling margin of 2½ per cent. over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

We = actual eccentric load; K = relative eccentricity coefficient; Wc = equivalent concentric value; Wc = We × K.

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" for *a*.

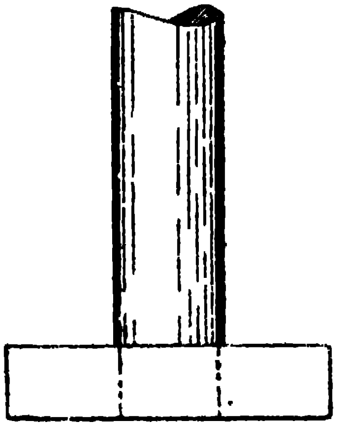
For full explanations of tables, see notes commencing page 192 L.



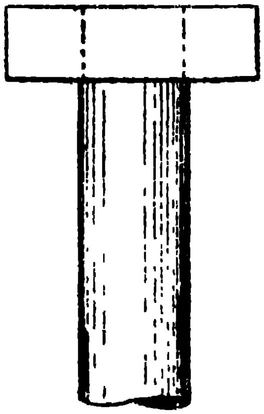
STANCHIONS (or COLUMNS).
Solid Round Steel.

Safe Concentric Loads, in Tons.
Ends Fixed.

Reference Mark.	Size, D inches.	HEIGHTS IN FEET.												
		4	6	8	10	11	12	13	14	15	16	18	20	22
13 X	7	223	210	197	184	177	170	164	157	151	144	131	118	104
12 X	6½	191	178	166	154	148	142	136	129	123	117	105	93·1	
11 X	6	161	149	138	127	121	115	110	104	98·9	93·3	81·9	70·6	
10 X	5½	133	123	112	102	97·4	92·2	87·0	81·8	76·6	71·4	61·1		
9 X	5	108	99·3	89·9	80·5	75·7	71·0	66·3	61·6	56·9	52·2			
8 X	4½	86·4	77·9	69·4	60·9	56·7	52·4	48·2	44·0	39·7				
7 X	4	66·6	59·0	51·5	43·9	40·2	36·4	32·6						
6 X	3½	49·3	42·7	36·1	29·5	26·2								
5 X	3	34·6	28·9	23·3	17·6									
4 X	2½	22·4	17·7	13·0										



BASE.*



CAP.

Bases and Caps are formed of heavy steel slabs, bored out and shrunk on to the accurately machined column ends.

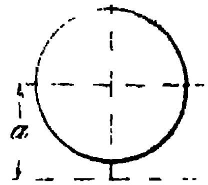
The above safe loads are tabulated for ratios of slenderness up to, but not exceeding 160.

Safe loads are in accordance with the working stresses prescribed by the London County Council (General Powers) Act, 1909, for stanchions of mild steel having "both ends fixed."

For other conditions and formulæ, see notes commencing page 192 L.

For explanation of properties, &c., see Part IV.

STANCHIONS (or COLUMNS).
Solid Round Steel.
Dimensions and Properties.



Diameter in inches.	Weight per foot in lbs.	Area in square inches.	Radius of Gyration.	Eccentricity Coefficients.	
				For Semi-diameter.	General.
7	130·9	38·485	1·750	5	1+1·15*a*
6½	112·9	33·183	1·625	5	1+1·23*a*
6	96·13	28·274	1·500	5	1+1·34*a*
5½	80·78	23·758	1·375	5	1+1·46*a*
5	66·76	19·635	1·250	5	1+1·60*a*
4½	54·07	15·904	1·125	5	1+1·78*a*
4	42·72	12·566	1·000	5	1+2·00*a*
3½	32·71	9·621	0·875	5	1+2·29*a*
3	24·03	7·069	0·750	5	1+2·67*a*
2½	16·69	4·909	0·625	5	1+3·20*a*

SLABS OF THE UNDERNOTED WIDTHS AND THICKNESSES ARE STOCKED IN LENGTHS OF ABOUT 12 FEET.

Width and Thickness. Inches.	Suitable for Diameters.	Width and Thickness. Inches.	Suitable for Diameters.
18 × 4	10 to 8 inches.	10 × 2	5 to 4 inches
16 × 3½	8 to 7 "	9 × 1¾	4 " 3½ "
14 × 3	7 to 6 "	8 × 1½	3½ " 2½ "
12 × 2½	6 to 5 "	—	—

Above sizes are for concentric loading.

Special calculations are necessary for the design of slab cap plates supporting eccentric loads. See Part IV.

In each case the weight per foot given is the **minimum that can be rolled, and a rolling margin of 2½ per cent.** over this must be allowed. See page 7.

Each weight per foot is for the shaft only. Weight of base, &c., to be added.

We=actual eccentric load; K=relative eccentricity **coefficient; Wc=equivalent concentric value; Wc=We×K.**

In axial eccentricity coefficients substitute actual value of "arm of eccentricity" **for *a*.**

For full explanations of tables, see notes commencing page 102 L.

PART VI.—LONDON.

Explanations of the Tables.

Pages 122L to 191L inclusive.

See Part IV. for general formulæ, explanations of properties, &c.

Part VI. All the tables in this part relate to simple and compound sections as stanchions, struts or columns.

These are compiled in accordance with the Amendment of London Building Acts, London County Council (General Powers) Act, 1909, Part IV., with respect to buildings of Steel Skeleton Construction in London, for text of which see page 211 L.

Arrangement. The arrangement is identical with Part II., also relating to stanchions, which complies with the principal London Building Acts, 1894 to 1908, and Provincial Building requirements.

Page Numbers. For convenience of reference the pages of this part bear the same numbers as those of Part II., with the addition of the letter "L" signifying "London."

Compound Stanchions. A full range of plate thicknesses is given for each joist and channel compound stanchion.

In a series of superimposed stanchions it is convenient and economical to retain the same section of joist or channel throughout, varying the plate areas, only, in accordance with the loads.

The tables afford a ready means of selecting suitable types for this purpose.

Latticed Stanchions.

The tabulated safe loads for each latticed stanchion, assume efficient bracing between the individual members composing the shaft.

Conventional *minimum* proportions of lattice bars and batten plates for concentric loading are indicated on the tables. Practical considerations will frequently cause the minimum proportions (especially of batten plates) to be increased considerably.

The conventional minimum proportions are not applicable to stanchions under "intentionally" eccentric loading.

Certain formulæ for the design of lattice bars are noticed in Part IV.

Angle and Tee Stanchions or Struts.

In structural steelwork applied to buildings, angle and tee stanchions or struts are usually the compression members of lattice girders or roof trusses.

The tabulated safe loads for the condition of "both ends fixed" are generally applicable to such members, unless each end connection consists of one bolt or one rivet only.

In the latter case refer to the condition of "hinged ends," page 199L.

Solid Rounds.

Solid round steel stanchions or columns are most useful in positions where considerations of space are of primary importance. For a given load the possible minimum of overall dimensions is attainable with this type.

Particular care should be taken to ensure *concentric* loading on solid round steel stanchions as the effect of eccentricity is relatively very great.

Details. Various types of stanchions with suitable designs for bases, caps and connections are illustrated in Part V.

Dimensions and Properties. All dimensions are stated in inches and all properties in inch units.

Overall Sizes. D = depth, B = breadth, and t = thickness.

Composition. The composition of compound stanchions is described in the first columns of the right-hand pages in the same manner as in Part I.

Plate Thicknesses. When the plating on each flange exceeds ¾ of an inch, two or more plates may be used to form the total thickness required.

Rivet Pitch. The standard rivet pitch for compound stanchions is 6 inches, the diameter being ⅞-inch or ¾-inch as indicated on the tables.

Weights per foot. Each weight per foot in lbs. of compound plated stanchions and of double angles back to back, includes an allowance for rivet heads at standard pitch.

Each weight per foot in lbs. is that of the plain or riveted shaft only. The weight of base, cap, connections, lattice bracing, batten plates, extra rivets, &c., requires to be added in estimating the total weight of a complete stanchion.

Areas. Each area in square inches is the superficial area of a cross section at right angles to the longitudinal axis.

Radii of Gyration. Least and greatest radii of gyration are tabulated for each stanchion.

Radii of Gyration.

The least radius of gyration is invariably printed in prominent type.

For each joist and channel and stanchions compounded of these—excepting No. 24 L, page 137 L, and Nos. 32 M to 29 M inclusive, page 149 L—the least radius of gyration is about "Axis Y—Y" passing through the centre of gravity of the figure and parallel to the web or webs.

The greatest radius of gyration for each of these sections is about "Axis X—X" passing through the centre of gravity of the figure and parallel to the flanges.

The converse applies to Nos. 24 L and 32 M to 29 M, noted above.

The tabulated radii of gyration for each tee and tee shaped stanchion formed of two angles back to back, are also about central axes, but the least radius may be about "Axis Y—Y" parallel to the stalk, or about "Axis X—X" parallel to the table, depending upon the dimensions of the section.

For each simple or latticed angle stanchion, the least radius of gyration is about the major "Axis V—V" of the inertia ellipse. The greatest radius for each of these sections is about the minor "Axis U—U" of the inertia ellipse.

For solid round steel stanchions, all radii of gyration about central axes are identical.

Rivet Holes.

No deduction is made for rivet holes in the calculation of radii of gyration of compound sections.

Tabular Loads. The tabulated safe loads are without exception relative to the least radius gyration.

Dimension "d." Dimension "d" in the tables of compound stanchions, pages 136 L to 149 L, and pages 154 L to 159 L, is the spacing of the component joists or channels upon which the tabulated properties are based.

Any increase or decrease of "d" will therefore increase or decrease the radius of gyration about "Axis Y—Y," and, with the exception of No. 24 L, page 137 L, and Nos. 32 M to 29 M, page 149 L, will also increase or decrease the tabulated safe loads.

The maximum increase of safe load is reached when "Axis X—X" becomes the axis of least radius, safe loads relative to this axis being constant for all values of "d."

The tabulated safe loads for Nos. 24 L and Nos. 32 M to 29 M are the maximum for these sections, and will be decreased when "Axis Y—Y" becomes the axis of least radius.

Concentric Loading. Each tabular load is described as "safe concentric."

This implies that the centre of application of the load or system of loading is, so far as practically possible, coincident with the central vertical axis of the stanchion, or in other words that there is no intentional eccentricity of loading.

Ratio of Slenderness. If the height of a stanchion is divided by its least radius of gyration in the same unit dimension (both generally expressed in inches) the quotient is termed the "ratio of slenderness."

Ratio of Slenderness.

l = height of stanchion in inches.

k = least radius of gyration in inches.

$\frac{l}{k}$ = ratio of slenderness.

Limiting Heights.

In the tables the nearest even height of a stanchion not exceeding that for which the "ratio of slenderness" is equal to 160 is taken as the limiting height for which a safe load is given.

Some authorities prefer to limit the height of a stanchion to the lesser of the two values :—

(1). 160 times the least radius of gyration.
(2). 40 times the least overall dimension D. or B.

Frequently limit (2) gives a lower height than limit (1).

Italics.

For this reason, safe loads on all heights greater than the limiting height by (2) are printed in italics in the tables.

Tabulated Safe Loads.

The tabulated safe loads have been calculated from the working stresses in tons per square inch, specified in the 1909 Amendment London Building Acts, for pillars of mild steel having "both ends fixed."

For these working stresses and other end conditions, see page 201 L.

Formulæ.

The following straight line formulæ are derived from the tables of specified working stresses and may be used in preference to interpolation for intermediate or for other ratios of length to least radius of gyration not tabulated in the "*Amendment.*"

MILD STEEL PILLARS.

Ratio of Length to Least Radius of Gyration.	Working Stress in Tons per square inch of section.	Condition of Ends.
0 – 100	$4{\cdot}5 - \frac{l}{40k}$	Hinged Ends.
100 – 140	$4{\cdot}5 - \left(2{\cdot}5 + \frac{\frac{l}{k} - 100}{20}\right)$	
0 – 140	$5{\cdot}5 - \frac{l}{40k}$	One End Hinged and One End Fixed.
140 – 180	$5{\cdot}5 - \left(3{\cdot}5 + \frac{\frac{l}{k} - 140}{20}\right)$	
0 – 160	$6{\cdot}5 - \frac{l}{40k}$	Both Ends Fixed.
160 – 210	$6{\cdot}5 - \left(4{\cdot}0 + \frac{\frac{l}{k} - 160}{20}\right)$	

l = height of pillar in inches
k = least radius of gyration in inches.

"Hinged ends" and "one end hinged, one end fixed."

Safe loads for "hinged ends" and "one end hinged, one end fixed" may be got directly from the tabular loads as follows :—

W = tabular safe load in tons for "both ends fixed."

W_x = required safe load in tons for another condition of ends.

A = tabular area of section in square inches.

$\frac{l}{k}$ = ratio of length to least radius of gyration, or ratio of slenderness.

For "hinged ends":—

"Hinged ends" and "one end hinged, one end fixed."

$\frac{l}{k}$ 0 to 100. $W_R = W - 2A.$

*$\frac{l}{k}$ 100 to 140. $W_R = W - \left(2A + \frac{\frac{l}{k} - 100}{40}\right)$

For "one end hinged, one end fixed":—

$\frac{l}{k}$ 0 to 140. $W_R = W - A.$

*$\frac{l}{k}$ 140 to 160. $W_R = W - \left(A + \frac{\frac{l}{k} - 140}{40}\right)$

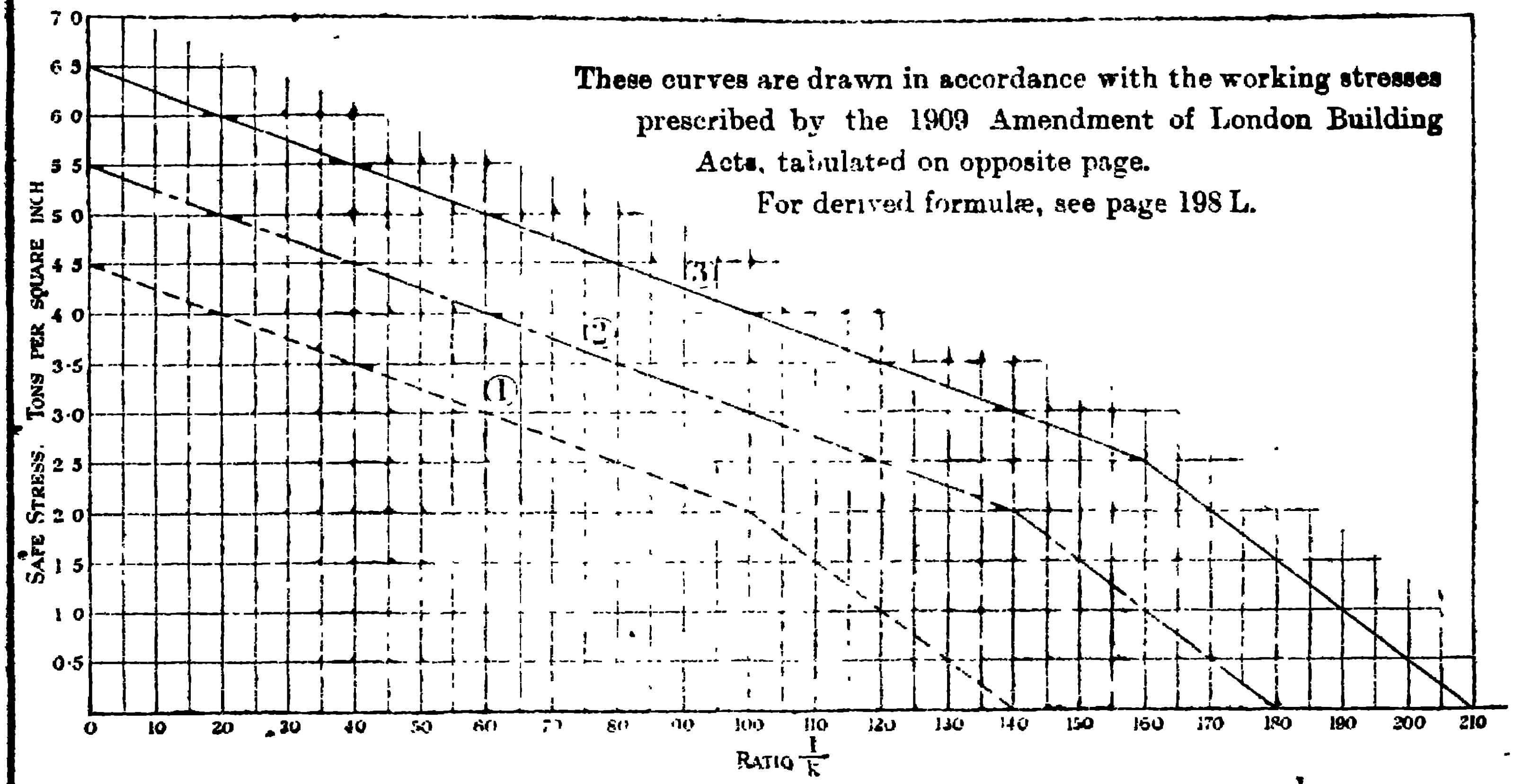
*For these higher ratios it will generally be more convenient to multiply the area by the working stress.

Economical Limiting Ratios.

It may be pointed out that 100, 140 and 160 respectively are the economical limiting ratios of slenderness for the three conditions of ends, as above these values the working stresses are reduced 100 per cent. more rapidly than below them.

In other words the reduction is at the rate of one ton per square inch for each increase of 40 of the ratios up to the foregoing limits, but at the rate of 2 tons per square inch for each similar increase beyond them.

WORKING STRESSES IN TONS PER SQUARE INCH OF SECTION, BY 1909 AMENDMENT OF LONDON BUILDING ACTS, FOR STANCHIONS OF MILD STEEL UNDER CONCENTRIC LOADING.



These curves are drawn in accordance with the working stresses prescribed by the 1909 Amendment of London Building Acts, tabulated on opposite page.

For derived formulæ, see page 198 L.

Curve (1). **Stanchions with "Hinged Ends."** .. .. **Variation of Working Stresses for Ratios of $\frac{l}{k}$ from 0 to 140.**

Curve (2). **Stanchions with "One End Hinged" and "One End Fixed."** .. **Variation of Working Stresses for Ratios of $\frac{l}{k}$ from 0 to 180.**

Curve (3). **Stanchions with "Both Ends Fixed."** .. **Variation of Working Stresses for Ratios of $\frac{l}{k}$ from 0 to 210.**

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Working Stresses in tons, per square inch of Section, for Stanchions of Mild Steel under Concentric Loading in accordance with the 1909 Amendment of London Building Acts.

$\frac{l}{k}$	(1).	(2).	(3).	$\frac{l}{k}$	(1).	(2).	(3).	$\frac{l}{k}$	(1).	(2).	(3).
0	4·5	5·5	6·5	72	2·7	3·7	4·7	142	..	*1·9*	2·95
4	4·4	5·4	6·4	74	2·65	3·65	4·65	144	..	*1·8*	2·9
6	4·35	5·35	6·35	76	2·6	3·6	4·6	146	..	*1·7*	2·85
8	4·3	5·3	6·3	78	2·55	3·55	4·55	148	..	*1·6*	2·8
10	4·25	5·25	6·25	80	2·5	3·5	4·5	150	..	*1·5*	2·75
12	4·2	5·2	6·2	82	2·45	3·45	4·45	152	..	*1·4*	2·7
14	4·15	5·15	6·15	84	2·4	3·4	4·4	154	..	*1·3*	2·65
16	4·1	5·1	6·1	86	2·35	3·35	4·35	156	..	*1·2*	2·6
18	4·05	5·05	6·05	88	2·3	3·3	4·3	158	..	*1·1*	2·55
20	4·0	5·0	6·0	90	2·25	3·25	4·25	160	..	*1·0*	2·5
22	3·95	4·95	5·95	92	2·2	3·2	4·2	162	..	*0·9*	2·4
24	3·9	4·9	5·9	94	2·15	3·15	4·15	164	..	*0·8*	2·3
26	3·85	4·85	5·85	96	2·1	3·1	4·1	166	..	*0·7*	2·2
28	3·8	4·8	5·8	98	2·05	3·05	4·05	168	..	*0·6*	2·1
30	3·75	4·75	5·75	100	2·0	3·0	4·0	170	..	*0·5*	2·0
32	3·7	4·7	5·7	102	*1·9*	2·95	3·95	172	..	*0·4*	*1·9*
34	3·65	4·65	5·65	104	*1·8*	2·9	3·9	174	..	*0·3*	*1·8*
36	3·6	4·6	5·6	106	*1·7*	2·85	3·85	176	..	*0·2*	*1·7*
38	3·55	4·55	5·55	108	*1·6*	2·8	3·8	178	..	*0·1*	*1·6*
40	3·5	4·5	5·5	110	*1·5*	2·75	3·75	180	..	*0·0*	*1·5*
42	3·45	4·45	5·45	112	*1·4*	2·7	3·7	182	..	..	*1·4*
44	3·4	4·4	5·4	114	*1·3*	2·65	3·65	184	..	..	*1·3*
46	3·35	4·35	5·35	116	*1·2*	2·6	3·6	186	..	..	*1·2*
48	3·3	4·3	5·3	118	*1·1*	2·55	3·55	188	..	..	*1·1*
50	3·25	4·25	5·25	120	*1·0*	2·5	3·5	190	..	..	*1·0*
52	3·2	4·2	5·2	122	*0·9*	2·45	3·45	192	..	..	*0·9*
54	3·15	4·15	5·15	124	*0·8*	2·4	3·4	194	..	..	*0·8*
56	3·1	4·1	5·1	126	*0·7*	2·35	3·35	196	..	..	*0·7*
58	3·05	4·05	5·05	128	*0·6*	2·3	3·3	198	..	..	*0·6*
60	3·0	4·0	5·0	130	*0·5*	2·25	3·25	200	..	..	*0·5*
62	2·95	3·95	4·95	132	*0·4*	2·2	3·2	202	..	..	*0·4*
64	2·9	3·9	4·9	134	*0·3*	2·15	3·15	204	..	..	*0·3*
66	2·85	3·85	4·85	136	*0·2*	2·1	3·1	206	..	..	*0·2*
68	2·8	3·8	4·8	138	*0·1*	2·05	3·05	208	..	..	*0·1*
70	2·75	3·75	4·75	140	*0·0*	2·0	3·0	210	..	..	*0·0*

(1) = Working stresses for "hinged ends."
(2) = " " "one end hinged, one end fixed."
(3) = " " "both ends fixed."

The working stresses for ratios of slenderness beyond the economical limits (see page 199 L) are printed in italics.

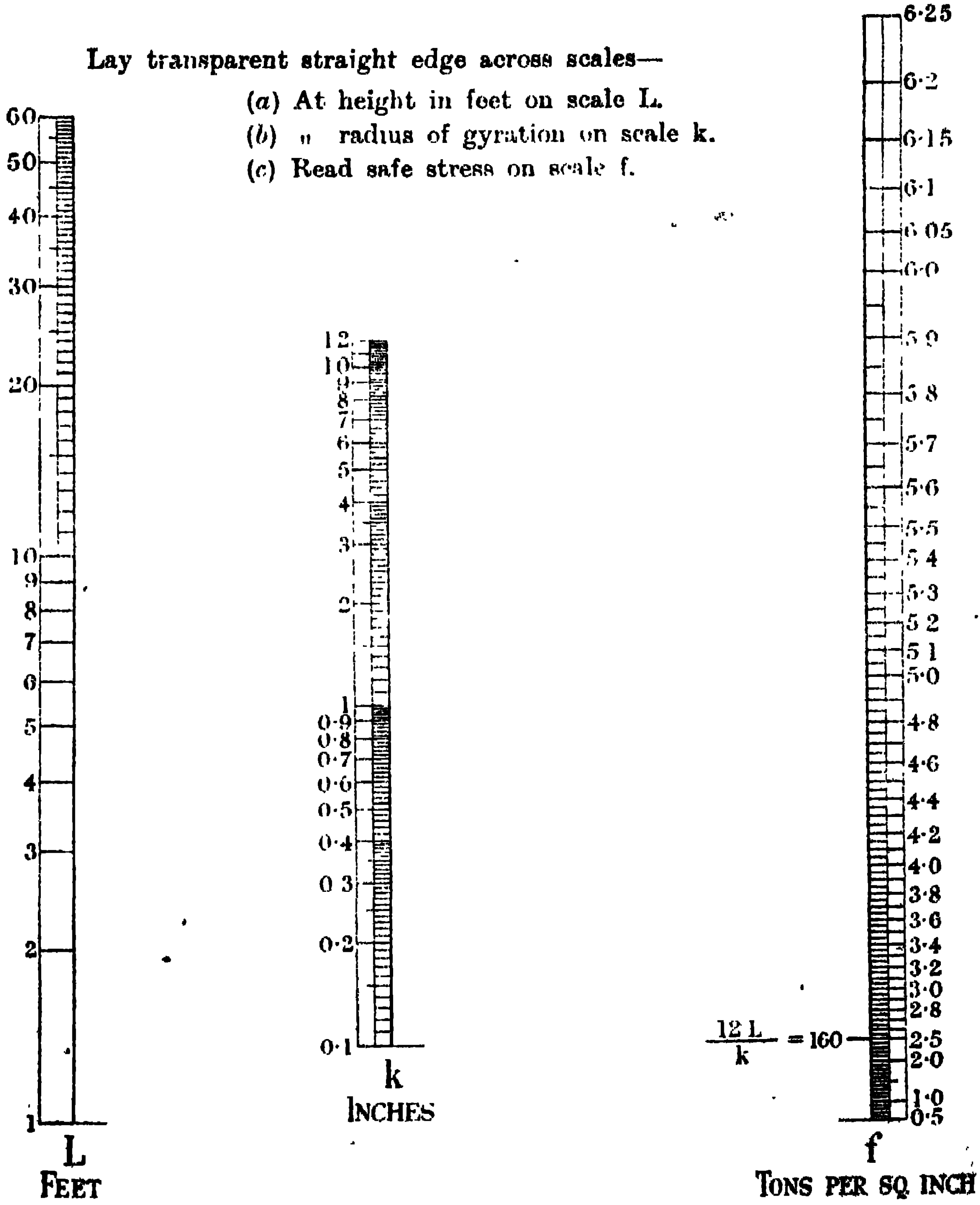
REDPATH, BROWN & CO., LIMITED.

Stanchions. L.C.C. (1909) Amendm

ALIGNMENT CHART I.

Lay transparent straight edge across scales—

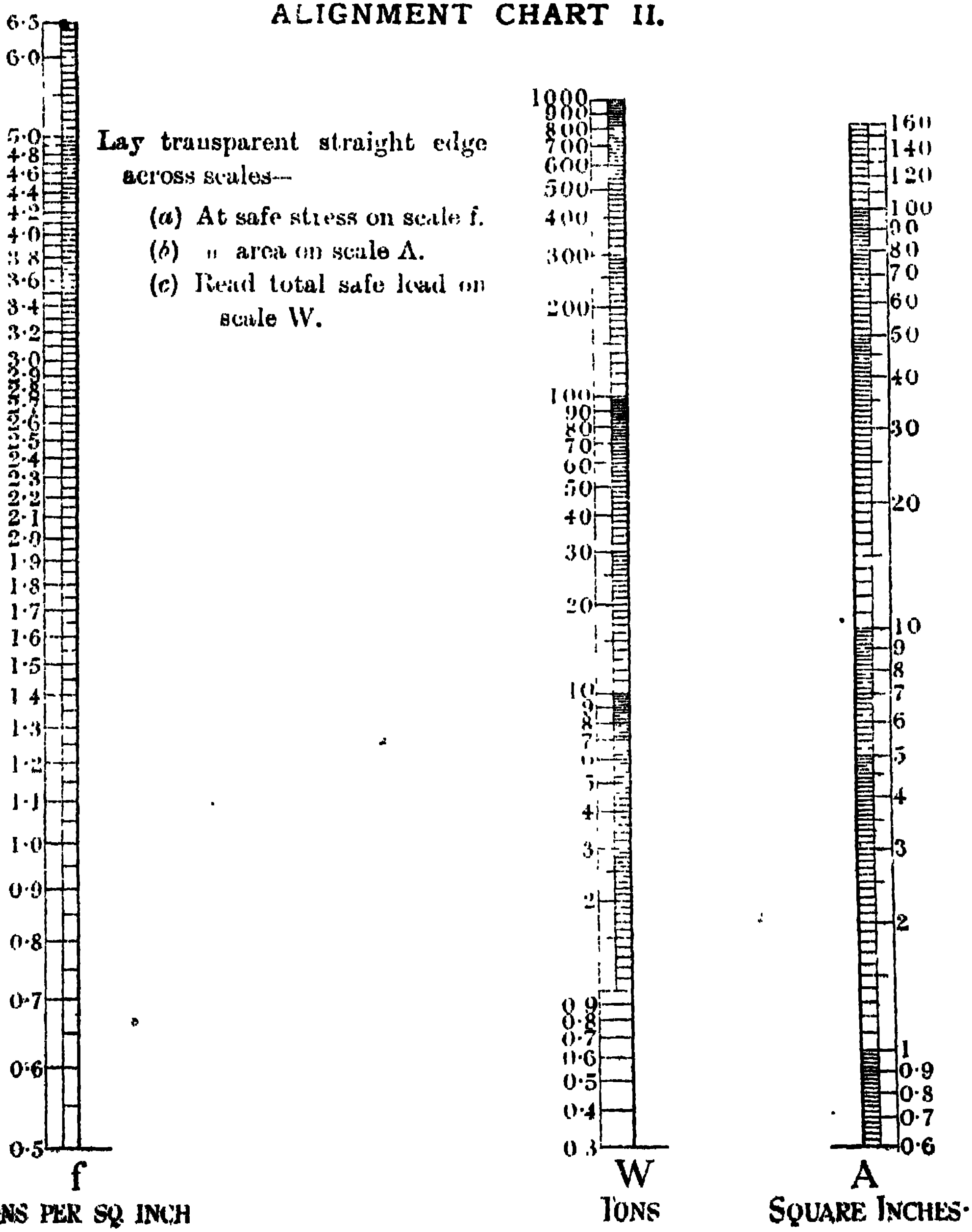
(*a*) At height in feet on scale L.
(*b*) " radius of gyration on scale k.
(*c*) Read safe stress on scale f.



REDPATH, BROWN & CO., LIMITED.

L.C.C. (1909) Amendment. **Stanchions.**

ALIGNMENT CHART II.



Lay transparent straight edge across scales—

(*a*) At safe stress on scale f.

(*b*) " area on scale A.

(*c*) Read total safe load on scale W.

Eccentric Loading.

Eccentric loading is of two descriptions, viz.:— "Accidental" and "Intentional"

Accidental Eccentricity.

"Accidental eccentricity" is due to the fact that the physical and geometrical axes of the practical column rarely coincide throughout the height, owing to the inherent but practically unobservable defects of material and workmanship.

The theory of the strength of columns is based on the primary assumption of a perfectly centred column of perfect material and workmanship, the factor of safety applied to the derived formulæ for ultimate strength being sufficient to cover the necessary allowance, *inter alia*, for "accidental eccentricity" thus giving suitable safe working stresses for concentric loading.

Intentional Eccentricity.

"Intentional eccentricity" occurs when the perpendicular distance from the centre of application of a load or system of loading to either or both principal axes of the stanchion is a quantity measurable by ordinary practical methods.

Eccentricity (general).

In these notes by "eccentricity" will now be understood "intentional eccentricity' as "accidental eccentricity" is not considered further.

Arm of Eccentricity.

The measurable distance referred to above is termed the "arm of eccentricity," and is expressed in inches.

Principal Axes.

The "principal axes" are the "axis of least radius" and "axis of greatest radius."

Loading.

Loading is said to be "eccentric about the axis" to which the "arm of eccentricity" is perpendicular.

Eccentric Loading.

The tabular eccentricity coefficients are derived from the general formulæ for eccentric loading, for which see Part IV.

For each stanchion, eccentricity coefficients relative to both of the "principal axes" of the section are given.

Prominent Type.

The eccentricity coefficients relative to the "axis of least radius" are printed in prominent type in the tables.

Axial Coefficients.

The coefficients in the tables under headings "Axis Y—Y," "Axis X—X," "Axis V—V," and "Axis U—U" are respectively relative to these "principal axes," and may be termed "axial coefficients."

To complete the "axial coefficients" it is only necessary to substitute for a_Y. a_X. a_V. a_U. the actual value in inches of the "arm of eccentricity."

The "axial coefficients" are of general application for any degree of eccentricity, care being taken to select the coefficient having the same reference letters as the axis about which the loading is eccentric.

Channel Coefficients.

Special note may be made of the "axial coefficients" for each channel stanchion, pages 150 L to 153 L.

As "axis Y—Y" for this type is not an axis of symmetry, it is necessary to consider on which side of this axis the eccentric loading is placed.

When the "arm of eccentricity" is measured in the same direction as dimension e_Y use coefficient "Axis Y—Y e_Y" and, conversely, when the centre of application of the load is on the other side of "Axis Y—Y" use coefficient "Axis Y—Y c_Y."

Angle and Tee Coefficients.

For each angle, tee and tee-shaped stanchion the "axial coefficients" relative to the asymmetrical axes V—V, U—U, and X—X, take into account the perpendicular distance e_v, e_u, or e_x to the extreme fibre of the section, irrespective of the side of the axis on which the loading occurs. The worst case is thus provided for.

Web and Flange Coefficients.

In addition to the "axial coefficients" for each joist and channel and for each stanchion compounded of either of these sections there are two coefficients for special conditions of eccentric loading, viz.:—"Web" and "Flange" respectively relative to "Axis Y—Y" and "Axis X—X."

These are applicable when the "arm of eccentricity" is identical with the perpendicular distance from "Axis Y—Y" or "Axis X—X" to the outer surface of the web or flange respectively.

This is usually taken to be the case in good construction when the eccentric load is transmitted by a girder properly connected to a side of a stanchion.

Equivalent Concentric Load.

By the use of the eccentricity coefficient for the axis about which a load or system of loading is eccentric an "equivalent concentric value" of the load relative to that axis may be obtained.

Let W_e = actual eccentric load in tons.
K = eccentricity coefficient for the axis about which "W_e" is eccentric.
W_c = equivalent concentric load value in tons for that axis.

Then $W_c = W_e \times K$.

Safe Eccentric Load.

It follows from the above that if a tabular concentric load is divided by the eccentricity coefficient printed in prominent type, the maximum safe eccentric load relative to the "axis of least radius" of the section is obtained directly.

Examples.

The following examples illustrate the application of the tables to the design of eccentrically loaded stanchions, and also the use of the Alignment Charts, pages 202 L and 203 L.

(A) Loading eccentric about "axis of least radius" only.

Example 1.—A stanchion 16 feet high supports an eccentric load of 58 tons, transmitted directly to its web surface by a girder.

Required a suitable section.

Select No. 19 J, page 122 L, steel joist 10 × 8 which will support a safe concentric load of 80·8 tons on 16 feet.

Multiply 58 tons, the actual concentric load, by 1·35 the "web" eccentricity coefficient for the section.

The product 78·3 tons is the equivalent concentric load value, therefore the selected stanchion is suitable.

Example 2.—A stanchion 20 feet high supports a system of eccentric loading amounting to 160 tons, the "arm of eccentricity" about the "axis of least radius" being 2 inches.

Required a suitable section.

Select No. 144 M, page 144 L, composed of two steel joists 14 × 6*b*, and four flange plates 14″ × ½″ which will support a safe concentric load of 303 tons on 20 feet.

Examples.

Substitute 2 ins., the given "arm of eccentricity," for a_Y and obtain $(1 + 0{\cdot}41 \times 2) = 1{\cdot}82$ as the "Axis Y—Y," or "axis of least radius" eccentricity coefficient.

Multiply 160 tons, the actual eccentric load, by 1·82.

The product 291 tons is the equivalent concentric load value, therefore the selected stanchion is suitable.

(B) Loading eccentric about "axis of greatest radius" only.

Example 3.—A stanchion 12 feet high supports an eccentric load of 70 tons transmitted directly to its flange surface by a girder.

Required a suitable section.

Select No. 31 P, page 156 L, composed of two steel channels 10 × 3½ and two flange plates 12″ × $\frac{5}{8}$″.

Note height 12 feet; area, 31·6 square inches, and greatest radius of gyration "Axis X—X" 4·57 inches.

Transfer these values to the Alignment Charts, pages 202 L and 203 L.

On Chart I. lay a straight edge across the three vertical scales at the height of 12 feet on scale L, at the radius of gyration 4·57 inches on scale k, and read safe stress as 5·71 tons per square inch on scale f.

On Chart II. lay straight edge at 5·71 tons on scale f, at the area 31·6 square inches on scale A and read safe concentric load for "Axis X—X" as 180 tons on scale W.

Divide 180 tons by 2·52 the flange eccentricity coefficient for the section.

Examples.

The quotient 71·4 tons is the safe flange eccentric load, therefore the selected stanchion is suitable.

Example 4.—A stanchion 14 feet high supports a system of eccentric loading amounting to 265 tons the "arm of eccentricity" about the "axis of greatest radius" being 1½ inches.

Required a suitable section.

Select No. 254 K, page 126 L, composed of one steel joist 20 × 7½ and four flange plates 14″ × ½″.

Note height 14 feet; area, 54·1 square inches and greatest radius of gyration "Axis X—X" 9·37 inches.

Transfer these values to the Alignment Charts, pages 202 L and 203 L.

On Chart I. by the method described read 6 tons per square inch on scale f.

On Chart II. read safe eccentric load for "Axis X—X" as 324 tons on scale W.

Substitute 1·5 the "arm of eccentricity" for a_x and obtain (1 + 0·13 × 1·5) = 1·195 as the "Axis X—X" or "axis of greatest radius" eccentricity coefficient.

Divide 324 tons by 1·195.

The quotient 270 tons is the safe load for an eccentricity of 1½ inches about "Axis X—X," therefore the selected stanchion is suitable.

(C) Loading eccentric about both axes.

Select a stanchion from the tables as in Examples 1 and 2 as if the loading were eccentric about the "axis of

Examples. least radius" only; then by use of the Alignment Charts and eccentricity coefficient for the "axis of greatest radius" check the section for the load eccentric about the "axis of greatest radius."

Combined Loading. If a stanchion supports concentric in addition to eccentric loading, the former, if treated separately, must be added to the equivalent concentric load value to give the total equivalent concentric load.

Maximum Load. **The actual load eccentric or concentric for the "axis of greatest radius" must in no case exceed the tabular load—calculated for the " axis of least radius."**

For notes on the location of the "centre of application" of load systems, see Part IV.

London County Council (General Powers) Act, 1909.

PART IV.

AMENDMENT OF LONDON BUILDING ACTS.

Definition of "principal Acts."

20. In this Part of this Act the expression "the principal Acts" means the London Building Acts 1894 to 1908.

Interpretation and effect of this Part of A

21. Words and expressions used in this Part of this Act shall unless the context otherwise requires bear the meanings assigned to them in the principal Acts and those Acts and this Part of this Act may be cited together as the London Building Acts 1894 to 1909.

For the purposes of this Part of this Act the expression "pillar" shall unless otherwise stated mean a metal pillar and shall include all columns and stanchions or an assemblage of columns or stanchions properly riveted or bolted together and the expression "girder" shall mean a metal girder or joist and the expression "tribunal of appeal" means the tribunal of appeal as constituted by this Part of this Act.

Provisions with respect to buildings of iron and steel skeleton construction.

22. Notwithstanding anything contained in the principal Acts requiring buildings to be enclosed with walls of the thicknesses and of the materials therein respectively described it shall be lawful to erect subject to the provisions of this section buildings wherein the loads and stresses are transmitted through each storey to the foundations by a skeleton framework of metal or partly by a skeleton framework of metal and partly by a party wall or party walls but buildings so erected shall

Provisions with respect to buildings, etc.

(subject to any exemptions contained in the principal Acts or any of them) be subject to and comply with all such provisions of the principal Acts or any of them and any byelaws in force thereunder as may not be inconsistent with or contrary to the provisions of this section The following are the provisions which shall apply in respect of the construction of the skeleton framework and the foundations walls floors staircases and other parts of the structure of such buildings:—

(1) All rolled steel used in such construction shall comply with the British standard specification for structural steel for bridges and general building construction from time to time in operation and every pillar or girder shall be of iron or steel or any other structural metal which may hereafter be standardised by the Engineering Standards Committee:

(2) The skeleton framework of a building together with the party wall or party walls (if any) upon which such framework bears shall be capable of safely and independently sustaining the whole dead load and the superimposed load bearing upon such framework and party wall or party walls:

(3) All pillars in the external walls of a building shall be completely enclosed and protected from the action of fire by a casing of brickwork terra-cotta concrete stone tiles or other incombustible materials at least four inches thick the whole being properly bonded or secured together:

(4) All girders in the external walls of a building shall be similarly enclosed and encased with brickwork

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc.

terra-cotta concrete stone tiles or other incombustible materials at least four inches thick properly tied and bonded or secured to the adjoining work but the casing on the underside of such girders and to the edges of the flanges thereof and plates and angles connected therewith may be of any thickness not less than two inches:

(5) All pillars and girders (other than pillars and girders in the external walls of a building) shall be protected from the action of fire by being encased to the satisfaction of the district surveyor and to a thickness of not less than two inches in brickwork terra-cotta concrete metal lathing and plaster or cement but the casing on the upper surface of the upper flange of all girders and on the lower surface of all subsidiary joists may be of any thickness not less than one inch. Wood firrings shall not be used in connexion with any such casing. Provided that this subsection shall not apply in the case of buildings of only one storey and not more than twenty-five feet in height:

(6) Every girder shall be secured against buckling whenever the length of the girder exceeds thirty times the width of the compression flange and the web of every girder shall be secured against buckling in every case in which the depth of the web exceeds sixty times the thickness thereof:

(7) The span of a girder shall not exceed twenty-four times the depth of the girder unless the calculated deflection of such girder is less than one four hundredth part of the span:

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings etc.

(8) Wherever two or more girders are arranged alongside and closely adjacent to one another and are intended to act together they shall be fixed together by means of iron separators and bolts or by riveted plates or in any other equally efficient manner approved by the district surveyor. Separators or plates or other members acting as separators shall not be placed at a distance apart exceeding five times the depth of the girders to which they are attached and shall also be placed immediately over all supports and immediately under or at all concentrated loads:

(9) All girders for supporting external walls shall be placed at the floor level of a storey or at a distance of not more than five feet above or below such floor level:

(10) Rivets shall be used in all cases where reasonably practicable but where bolts are used they shall extend through the full thickness of the nuts attached thereto and the nuts shall in all cases be so secured as to avoid the risk of their becoming loose. The distance from the edge of a rivet hole or bolt hole to the edge of the plate bar or member shall not be less than the diameter of the rivet or bolt. Rivets shall be so placed that their centres shall not be closer together than three times the diameter of the rivets. The pitch of rivets shall be measured in a continuous straight line and such straight line pitch in girders pillars and roofwork shall not exceed sixteen times the thickness of the thinnest plate bar or member through which they pass:

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc.

(11)—(A) An external wall may be of any thickness not less than eight and a half inches for the topmost twenty feet of its height and thirteen inches for the remainder of its height below such topmost twenty feet. Provided that a less thickness shall be allowed in any case in which under the London Building Act 1894 such less thickness is prescribed but that nothing in this sub-section shall override any of the requirements of this section in regard to the thickness of casing in connexion with pillars and girders and that in any case in which an external wall or portion of an external wall is not supported or carried or secured by metal framework within the limits of height and length prescribed by the First Schedule to the London Building Act 1894 for the purpose of determining the thickness of walls such external wall or portion of external wall shall be of a thickness not less than that prescribed by such schedule:

(B) All party walls shall be of the thicknesses prescribed by the principal Acts:

(C) All brickwork and work in which terra-cotta concrete stones tiles or other similar materials are used shall be executed in Portland cement mortar and shall be bedded close up to the metal framework without any intervening cavity and all joints shall be made full and solid. The cement so used shall be in accordance with the British standard specification from time to time in operation. Provided that in party walls (exclusive of any parts thereof immediately surrounding metal

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc

framework) or other internal brickwork not constructed to carry loads or stresses provided for under this section lime mortar may be used in accordance with the provisions of the principal Acts and any bye-laws in force thereunder:

(12)—(A) No plate or bar in any steel or wrought iron pillar shall in any part be less than a quarter of an inch thick and the bases of all such pillars shall be at right angles to the axis:

(B) All joints in such pillars shall be close butted with cover-plates properly riveted and all joints between such pillars shall be properly fixed and made and unless unavoidable no joint shall be made between such pillars except at or as near as may be reasonably practicable to the level of a girder properly secured to such pillars:

(C) The foot of every such pillar shall have a proper base-plate riveted thereto with sufficient gusset pieces to distribute properly the load on the foundations and the gusset pieces shall have sufficient rivets to transmit the whole of the load on to the base-plates:

(D) Where any such pillars are built up hollow the cavities shall either be filled up with concrete or be covered in at both ends by metal plates riveted thereto:

(13)—(A) The width of every cast-iron pillar shall be not less than five inches and the metal of which such pillar is composed shall not be in any part of less thickness than three-quarters of an inch or

London County Council (General Powers) Act, 1909.

one-twelfth of the least width of such pillar (whichever shall be the greater):

Provisions with respect to buildings, etc.

(B) The cap and base of every such pillar shall be in one piece with the pillar or be connected thereto with a properly turned and bored joint sufficiently fixed:

(C) The ends of all such pillars shall be at right angles to the axis:

(D) All joints between such pillars shall be at or as near as may be reasonably practicable to the level of a girder properly secured to such pillars and shall be fixed and made with not fewer than four bolts of not less diameter than the least thickness of metal in the pillar. If more than four bolts are used the diameter of the bolts may be reduced proportionately but no bolt shall be less than three-quarters of an inch in diameter:

(E) The base of every such pillar shall have such area as may be necessary to distribute properly the load on the foundations:

(14) The base of every pillar shall be properly bedded so as to transmit uniformly the load upon such pillar to the foundations:

(15) The stress in any metal interposed between the ends of a superimposed pillar and a pillar beneath shall not exceed the stress on the superimposed pillar and the least width across such interposed metal shall not be less than the least width of the superimposed pillar:

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc.

(16) All floors and staircases (together with their enclosing walls) shall be constructed throughout of fire-resisting materials and be carried upon supports of fire-resisting materials:

(17) All structural metalwork comprised in the skeleton framework of a building shall be cleaned of all scale dust and loose rust and be thoroughly coated with one coat of boiled oil tar or paint before erection and after erection shall receive at least one additional coat. Where such metalwork is to be embedded or encased in brickwork terra-cotta concrete stone tiles or other incombustible materials one coat of Portland cement wash of adequate consistency applied after erection may be used in lieu of coats of oil tar or paint:

(18)—(A) The dead load of a building shall consist of the actual weight of walls floors roofs partitions and all other permanent construction comprised in such building:

(B) The superimposed load in respect of a building shall consist of all loads other than the dead load:

(C) For the purpose of calculating the loads on foundations pillars (including brick pillars) piers walls framework girders and other constructions carrying loads in buildings the superimposed load on each floor and on the roof shall be estimated as equivalent to the following dead load:—

For a floor intended to be used wholly or principally for the purposes of human habitation or for domestic purposes seventy pounds per square foot of floor area;

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc.

For a floor intended to be used wholly or principally for the purpose of an office or a counting-house or for any similar purpose one hundred pounds per square foot of floor area;

For a floor intended to be used wholly or principally for the purpose of a workshop or retail shop one hundred and twelve pounds per square foot of floor area;

For every floor in a building of the warehouse class not intended to be used wholly or principally for any of the purposes aforesaid not less than two hundred and twenty-four pounds per square foot of floor area. In every building of the warehouse class a notice shall be exhibited in a conspicuous place on each storey of such building stating the maximum superimposed load per square foot which may be carried on the floor of such storey;

For a roof the plane of which inclines upwards at a greater angle than twenty degrees with the horizontal the superimposed load (which shall for this purpose be deemed to include wind pressure) shall be estimated at twenty-eight pounds per square foot of sloping surface;

For all other roofs the superimposed load shall be estimated at fifty-six pounds per square foot measured on a horizontal plane:

Provided that if the superimposed load on any floor or roof is to exceed that herein-before specified for such floor or roof such greater load

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc.

shall be provided for pursuant to subsection (2) of this section:

Provided also that in the case of any floor intended to be used for a purpose for which a superimposed load is not specified in this subsection the superimposed load to be carried on such floor shall be provided for pursuant to the said subsection (2):

(19) For the purpose of calculating the total load to be carried on foundations pillars (including brick pillars) piers and walls in buildings of more than two storeys in height the superimposed loads for the roof and topmost storey shall be calculated in full in accordance with the last preceding subsection of this section but for the lower storeys a reduction of the superimposed loads shall be allowed as follows:—

For the storey next below the topmost storey a reduction of five per centum of the full superimposed load for such next storey calculated as aforesaid;

For the next succeeding lower storey a reduction of ten per centum of the full superimposed load for such storey calculated as aforesaid and for each succeeding lower storey a further reduction of five per centum of the full superimposed load for each such storey calculated as aforesaid. Provided always that the total reduction in respect of any storey shall not exceed fifty per centum of the full superimposed load for such storey;

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc.

No such reduction as aforesaid shall be allowed in the case of a building of the warehouse class:

(20) All buildings shall be so designed as to resist safely a wind pressure in any horizontal direction of not less than thirty pounds per square foot of the upper two-thirds of the surface of such buildings exposed to wind pressure:

(21)—(A) The working stresses on pillars of cast iron or mild steel due to the loads thereon (other than stresses induced by wind pressure) shall not exceed those specified in the two next following tables according to the several ratios therein specified or a proportionate load for intermediate or other ratios:—

CAST-IRON PILLARS.

Ratio of Length to least Radius of Gyration.	Working Stresses in Tons per Square Inch of Net Section.		
	Hinged Ends.	One End hinged and one End fixed.	Both Ends fixed.
20	3·5	4·0	4·5
30	3·0	3·5	4·0
40	2·5	3·0	3·5
50	2·0	2·5	3·0
60	1·5	2·0	2·5
70	1·0	1·5	2·0
80	·5	1·0	1·5

London County Council (General Powers) Act, 1909.

MILD STEEL PILLARS.

Provisions with respect to buildings, etc.

Ratio of Length to least Radius of Gyration.	Working Stresses in Tons per Square Inch of Section.		
	Hinged Ends.	One End hinged and one End fixed.	**Both Ends fixed.**
20	4·0	5·0	6·0
40	3·5	4·5	5·5
60	3·0	4·0	5·0
80	2·5	3·5	4·5
100	2·0	3·0	4·0
120	1·0	2·5	3·5
140	0·0	2·0	3·0
160		1·0	2·5
180		0·0	1·5
200			0·5
210			0·0

(B) The working stresses on wrought-iron pillars due to the loads thereon (other than stresses induced by wind pressure) shall not exceed two-thirds of the stresses herein-before specified with respect to mild steel pillars:

(C) Any such pillar eccentrically loaded shall have the stresses caused by such eccentricity computed and the combined stresses resulting from such eccentricity at any part of such pillar when added to all other stresses at that part shall in no case exceed the working stresses specified in this subsection:

Provisions with respect to buildings, etc.

Provided that working stresses exceeding those specified in paragraphs (A) (B) and (C) of this subsection by not more than twenty-five per centum may be allowed in cases in which such excess is due to stresses induced by wind pressure:

(D) The eccentric load of a pillar shall be considered to be distributed uniformly over the area of the cross section of such pillar at the next lower level at which such pillar is fixed and secured in the direction of eccentricity:

(22) The working stresses of iron and steel (except in the case of pillars as herein-before provided) shall not exceed the following:—

	Working Stresses in Tons per Square Inch.			
	Tension.	Compression.	Shearing.	Bearing.
Cast iron - -	1·5	8	1·5	10
Wrought iron -	5	5	4	7
Mild steel -	7·5	7·5	5·5	11

(23) In the case of any rivet used in double shear the working shear on such rivet shall not exceed one and three-quarter times the working shear allowed under this section on a like rivet when used in single shear.

London County Council (General Powers) Act, 1909.

Provisions with respect to buildings, etc.

(24) The pressures of foundations on the natural ground shall not exceed the following :—

——	Tons per Square Foot.
Natural bed of soft clay or wet or loose sand - -	1
Natural bed of ordinary clay or confined sand - -	2
Natural bed of compact gravel London blue clay or chalk	4

(25) The pressure on concrete foundations shall not exceed twelve tons per square foot:

(26) No disengaged brick pillar shall have a height without proper lateral supports of more than six times its least width but any such pillar with proper lateral supports may have a height between such supports not more than twelve times the least width of such pillar. Such width shall in no case be less than thirteen-and-a-half inches:

(27) The pressure on any brickwork shall not exceed the following :—

——	Tons per Square Foot.
Blue brick in cement mortar - - - - - -	12
Hard brick (including London stock) in cement mortar	8
Ordinary brick in cement mortar - - - -	5

(28) The Council may prescribe the materials and the proportions of the materials to be used in any concrete provided under the provisions of this

Provisions with respect to buildings, etc.

section to which the provisions of the principal Acts or any of them or any byelaws in force thereunder do not apply:

(29) It shall be lawful to make any addition to or alteration of or to do other work to in or upon a building in accordance with the provisions of this section provided that the loads and stresses in the part of a building so added or altered or to in or upon which such other work is done are transmitted from the roof to the foundations by a skeleton framework of metal or partly by a skeleton framework of metal and partly by a party wall or party walls and the provisions of this section shall in all respects apply to such part of a building as if the same were a separate building:

(30) Any structural metal hereafter standardised by the Engineering Standards Committee as before mentioned shall be used in the erection of buildings or additions alterations or other work made or done under the provisions of this section only subject to such terms and conditions as the Council may think fit to attach either generally or in any particular case to the use of such metal but any person dissatisfied with any term or condition attached by the Council may appeal to the tribunal of appeal. Any person failing to comply with any such term or condition attached by the Council or (in the event of appeal) by the tribunal of appeal shall be liable to a penalty to be recoverable in a summary manner not

Provisions with respect to buildings, etc.

exceeding twenty pounds and to a daily penalty not exceeding the like amount:

(31) In the case of the erection of a new building of metal skeleton framework or the making of any addition or alteration or the carrying out of other work under the provisions of this section the notice required to be served on the district surveyor under section 145 of the London Building Act 1894 shall be accompanied (A) in the case of a new building by plans and sections of sufficient detail to show the construction thereof together with a copy of the calculations of the loads and stresses to be provided for and particulars of the materials to be used and should such plans sections calculations or particulars be in the opinion of the district surveyor not in sufficient detail the person depositing the same shall furnish the district surveyor with such further plans sections calculations or particulars as he may reasonably require and (B) in the case of an alteration or addition or other work as aforesaid by such plans sections calculations and particulars as the district surveyor may reasonably require:

(32) The district surveyor may for the purpose of due supervision of the construction of a building require to be furnished with reasonable proof as to the quality of metal to be used in such construction and may if not furnished with such proof or for any other reason require the builder or other person causing or directing the work to be executed to make any tests which the district surveyor may

Provisions with respect to buildings, etc.

consider necessary and to drill any pillar (in all cases if reasonably practicable before the same is encased) at any point to ascertain its thickness:

(33) Any person dissatisfied with any requirement of the district surveyor under this section may within fourteen days of the date of the service of a notice from the district surveyor of such requirement appeal to a petty sessional court who may make an order affirming such requirement or otherwise and every builder or other person failing to comply with any such order shall be liable to a penalty (to be recoverable in a summary manner) not exceeding twenty pounds a day during every day of the continuance of the non-compliance with such order:

(34) In order to facilitate the erection of buildings of metal skeleton framework it shall be lawful for the Council to modify or waive any of the requirements of sub-sections (3) (4) (5) (8) (9) (11) (12) (B) (17) (20) (24) and (26) of this section upon and subject to such terms and conditions as they may think fit and any person dissatisfied with the refusal of the Council to modify or waive any of such requirements or with any term or condition which the Council may attach to any modification or waiver may appeal to the tribunal of appeal. Any person failing to comply with any term or condition attached by the Council or (in the event of appeal) by the tribunal of appeal to such modification or waiver shall be liable to a penalty to be recoverable in a summary manner not

Provisions with respect to buildings, etc.

exceeding twenty pounds and to a daily penalty not exceeding the like amount:

(35) If the Council within the period of one month or in the event of such period of one month commencing or expiring on any day between the eighth day of August and the fourteenth day of September (both inclusive) then within a period of two months after the receipt of a written application for the modification or waiver of any of the requirements of this section which the Council are empowered to waive or modify fail to give notice to the applicant of their refusal or grant thereof the Council shall be deemed to have granted such application.

Power to make regulations as to use of reinforced concrete.

23.—(1) The Council may make regulations with respect to the construction of buildings wholly or partly of reinforced concrete and with respect to the use and composition of reinforced concrete in such construction and for the purpose of framing such regulations may carry out such investigations and make such tests as they may deem necessary and the provisions of this section and of any such regulations shall (subject to any exemptions contained in the principal Acts or any of them) have effect notwithstanding any provisions of the said Acts or any of them or any byelaw in force thereunder which may be inconsistent therewith or contrary thereto.

(2) Subject to such regulations as aforesaid buildings may be constructed wholly or partly of reinforced concrete but except as provided by this section or by such regulations buildings so constructed shall (subject to any exemptions contained in the principal Acts or any of them)

be subject to and comply with all such provisions of the said Acts or any of them and of any byelaws in force thereunder as may not be inconsistent with or contrary to the provisions of this section or any regulations in force thereunder.

Power to make regulations as to use of reinforced concrete.

(3) No such regulations shall have any force or effect unless or until they shall have been submitted to and confirmed at a meeting of the Council subsequent to that at which the regulations shall have been made nor shall any such regulations have any force or effect until the same shall have been allowed by the Local Government Board.

(4) The Council shall give to the Surveyors' Institution the Institution of Civil Engineers the Royal Institute of British Architects and the Concrete Institute notice of their intention to apply to the Local Government Board for allowance of any regulations made under this section.

(5) All regulations made and confirmed and allowed as aforesaid shall be published in the London Gazette and printed and hung up at the County Hall and be open to public inspection without payment and copies thereof shall be delivered to any person applying for the same on payment of such sum not exceeding twopence as the Council shall direct and such regulations when so published shall come into operation upon a date to be fixed by the Local Government Board in allowing the regulations and the production of a printed copy of such regulations authenticated by the seal of the Council shall be evidence of the existence and of the due making allowance and publication of such regulations in all

prosecutions or other proceedings under the same without adducing proof of such seal or of the fact of such making confirmation allowance of publication of such regulations.

This Part of Act and regulations to form part of Part VI. of London Building Act 1894.

24.—The foregoing provisions of this Part of this Act and any regulations in force thereunder shall be deemed to form part of Part VI of the London Building Act 1894 and this Part of this Act and any references in the principal Acts to the said Act of 1894 or any Part thereof shall be construed accordingly.

Tribunal of appeal, etc.

25.—(1) For the purposes of this Part of this Act the tribunal of appeal shall consist of the three members of the tribunal of appeal from time to time appointed under section 175 of the London Building Act 1894 and of one member appointed by the Council of the Institution of Civil Engineers.

(2) In the event of their being an equality of votes on the tribunal of appeal on any matter arising under this Part of this Act the member acting as the chairman of such tribunal for the time being shall have a second or casting vote.

(3) Regulations made or to be made under section 184 of the London Building Act 1894 shall apply to appeals under this Part of this Act to the tribunal of appeal.

(4) Subject to the provisions of this section the provisions of section 156 and sections 175 to 186 (inclusive) of the London Building Act 1894 shall apply to the tribunal of appeal and appeals thereto under this Part of this Act as if the tribunal of appeal referred to in those sections were the tribunal of appeal constituted by this Part of this Act.

London County Council (General Powers) Act, 1909.

Increased fee to district surveyor in certain cases.

26.—(1) Where under the provisions of this Part of this Act or any regulations in force thereunder any building is erected or any addition or alteration or other work is made or done to or on any building the district surveyor shall be entitled with regard to such building addition alteration or other work to a fee equal to two and a half times the amount of the fee specified with regard to new buildings in Part I. of the Third Schedule to the London Building Act 1894 calculated as follows:—

New Buildings.

Upon the area and height of the building as specified in the said Part I. of the said Third Schedule.

Additions.

Upon the area and height of the addition (including therein such portion of the building as may be structurally affected by any alteration or other work necessitated by or involved in the making of the addition) as if such addition had been a new building of the same area and height.

Alterations and other Works.

Upon the area and height of the portion of the building structurally affected by the alteration or other work (not necessitated by or involved in the making of an addition) as if such portion had been a new building of the same area and height.

Provided that in calculating the fees payable under this section no regard shall be had to the proviso contained in the said Part I. of the said Third Schedule.

London County Council (General Powers) Act, 1909.

Increased fee to district surveyor in certain cases.

Provided also that the fees payable to the district surveyor in respect of arches or fire-resisting floors over or under public ways the formation or closing of opening in party walls and on chimneys and flues shall be those specified in the said Part I. of the said Third Schedule.

(2) One-fifth of the amount of any fee payable under this section shall be paid to the district surveyor at the time when notice is served on him under section 145 of the London Building Act 1894.

(3) Subject to the provisions of this section all the provisions of the London Building Act 1894 relating to the payment to and recovery by the district surveyor of fees shall extend and apply to the fees provided for by this section.

Saving existing powers and rights.

27. The provisions of this Part of this Act and any regulations in force thereunder shall not apply in the case of the erection or alteration of or the making of an addition to or the doing of other work to in or upon any building in accordance with the provisions of the principal Acts and nothing in this Part of this Act or in any regulations in force thereunder shall take away or prejudice any powers rights privileges or exemptions vested in or enjoyed by any person under the principal Acts or any of them.